



# PROJECT IDENTIFICATION FORM (PIF) <sup>1</sup>

PROJECT TYPE: Full-sized Project

TYPE OF TRUST FUND: GEF Trust Fund

## PART I: PROJECT IDENTIFICATION

Project Title:	Demonstration and assessment of battery-electric vehicles for mass transit in Colombia		
Country(ies):	Colombia	GEF Project ID: <sup>2</sup>	5199
GEF Agency(ies):	IADB (select) (select)	GEF Agency Project ID:	
Other Executing Partner(s):	C40 Cities Climate Leadership Group in partnership with the Clinton Climate Initiative (C40-CCI)	Submission Date:	2012-12-21
GEF Focal Area (s):	Climate Change	Project Duration (Months)	36
Name of parent program (if applicable): ➤ For SFM/REDD+ <input type="checkbox"/>		Agency Fee (\$):	209,000

## A. FOCAL AREA STRATEGY FRAMEWORK<sup>3</sup>:

Focal Area Objectives	Expected FA Outcomes	Expected FA Outputs	Trust Fund	Indicative Grant Amount (\$)	Indicative Co-financing (\$)
CCM-1 (select)	Technologies successfully demonstrated, deployed, and transferred	Innovative low-carbon technology demonstrated and deployed	GEFTF	1,000,000	27,200,000
CCM-1 (select)	Enabling policy environment and mechanisms created for technology transfer  Greenhouse gas (GHG) emissions avoided (est. 66,000 t CO <sub>2</sub> -eq)	National strategies for the deployment and commercialization of innovative technologies adopted	GEFTF	400,000	750,000
CCM-4 (select)	Sustainable transport and urban policy and regulatory frameworks adopted and implemented	Cities adopting low-carbon programs	GEFTF	300,000	300,000
CCM-4 (select)	Increased investment in less GHG-intensive transport and urban systems  Greenhouse gas (GHG) emissions avoided (same as above)	Investment mobilized	GEFTF	400,000	600,000
(select) (select)			(select)		
(select) (select)			(select)		
(select) (select)			(select)		
(select) (select)			(select)		
(select) (select)			(select)		
(select) (select)	Others		(select)		
Sub-Total				2,100,000	28,850,000
Project Management Cost <sup>4</sup>			GEFTF	<b>100,000</b>	1,050,000
<b>Total Project Cost</b>				2,200,000	29,900,000

<sup>1</sup> It is very important to consult the PIF preparation guidelines when completing this template.

<sup>2</sup> Project ID number will be assigned by GEFSEC.

<sup>3</sup> Refer to the reference attached on the [Focal Area Results Framework](#) when filling up the table in item A.

<sup>4</sup> GEF will finance management cost that is solely linked to GEF financing of the project. PMC should be charged proportionately to focal areas based on focal area project grant amount.

## B. PROJECT FRAMEWORK

<b>Project Objective: The objective of the Project is to promote battery-electric, large-capacity vehicles for mass transit in Colombia by means of removing technology, regulatory, awareness and financial barriers, as a measure to reduce GHG emissions and improve local air-quality</b>						
<b>Project Component</b>	<b>Grant Type</b>	<b>Expected Outcomes</b>	<b>Expected Outputs</b>	<b>Trust Fund</b>	<b>Indicative Grant Amount (\$)</b>	<b>Indicative Cofinancing (\$)</b>
1. Policy development to support a large-scale sector transformation	TA	Favorable local and national policies and regulatory environment for a deployment of electric vehicles in Colombia, in line with the Colombian Low-Carbon Development Strategy	<p>Policies, regulations and guidelines to integrate advanced, clean vehicle technologies in urban mobility plans and projects</p> <p>Standards for electric vehicles, batteries and battery charging technologies</p> <p>Regulations for battery re-use, recycling and disposal</p> <p>Safety standards for electric vehicles</p>	GEFTF	200,000	450,000
2. Demonstration and assessment of articulated, battery-electric buses in Bogotá's Bus Rapid Transit (BRT) system	Inv	Demonstration of the technical and operational feasibility of articulated, battery-electric buses in a BRT system	<p>8 articulated, battery-electric buses tested in Bogotá's BRT system</p> <p>Bus charging infrastructure installed and operational</p> <p>Bus testing protocols, data acquisition equipment and assessment tools procured</p> <p>Bus testing results disseminated</p>	GEFTF	1,700,000	27,600,000
3. Design of financial mechanisms for the deployment of battery-electric buses	TA	Demonstration of the financial feasibility of battery-electric buses in a BRT system	Business models for the adoption of battery-electric buses	GEFTF	100,000	200,000
4. Training, outreach and communication	TA	Increased technical capacities and awareness related to electric vehicles	<p>A technology road-map for the adoption of electric vehicles</p> <p>Technical-assessment reports and technology overviews</p> <p>Training to bus operators, transport authorities and auto industry</p>	GEFTF	100,000	600,000
	(select)			(select)		
	(select)			(select)		
	(select)			(select)		
	(select)			(select)		
	(select)			(select)		
	(select)			(select)		

	Sub-Total		2,100,000	28,850,000
	Project Management Cost <sup>5</sup>	GEFTF	100,000	1,050,000
	<b>Total Project Costs</b>		2,200,000	29,900,000

**C. INDICATIVE CO-FINANCING FOR THE PROJECT BY SOURCE AND BY NAME IF AVAILABLE, (\$)**

Sources of Cofinancing	Name of Cofinancier	Type of Cofinancing	Amount (\$)
GEF Agency	IADB (Sustainable Energy and Climate Change Initiative)	Grant	1,850,000
GEF Agency	IADB (Multilateral Investment Fund)	Grant	1,000,000
National Government	Ministry of Environment and Sustainable Development (MESD)	In-kind	300,000
National Government	Ministry of Transport (MoT)	In-kind	100,000
Private Sector	Express del Futuro	In-kind	6,500,000
Private Sector	BYD Company Limited (BYD)	In-kind	20,000,000
Foundation	C40 Cities Climate Leadership Group in partnership with the Clinton Climate Initiative (C40-CCI)	In-kind	150,000
(select)		(select)	
(select)		(select)	
(select)		(select)	
<b>Total Cofinancing</b>			29,900,000

**D. GEF/LDCF/SCCF/NPIF RESOURCES REQUESTED BY AGENCY, FOCAL AREA AND COUNTRY<sup>1</sup>**

GEF Agency	Type of Trust Fund	Focal Area	Country Name/Global	Grant Amount (a)	Agency Fee (b) <sup>2</sup>	Total c=a+b
IADB	GEFTF	Climate Change	Colombia	2,200,000	209,000	2,409,000
(select)	(select)	(select)				0
(select)	(select)	(select)				0
(select)	(select)	(select)				0
(select)	(select)(select)	(select)				0
(select)	(select)(select)	(select)				0
(select)	(select)(select)	(select)				0
(select)	(select)(select)	(select)				0
(select)	(select)(select)	(select)				0
(select)	(select)(select)	(select)				0
<b>Total Grant Resources</b>				2,200,000	209,000	2,409,000

<sup>1</sup> In case of a single focal area, single country, single GEF Agency project, and single trust fund project, no need to provide information for this table

<sup>2</sup> Please indicate fees related to this project.

<sup>5</sup> Same as footnote #3.

## **PART II: PROJECT JUSTIFICATION**

### **A. DESCRIPTION OF THE CONSISTENCY OF THE PROJECT WITH:**

#### A.1.1 the [GEF focal area/LDCF/SCCF](#) strategies /[NPIF](#) Initiative:

The GEF-5 climate change strategy promotes environmentally sound technologies at different stages of the technology development cycle, including the market demonstration of innovative, emerging technologies. The proposed project on “Demonstration and assessment of battery-electric vehicles for mass transit in Colombia” (hereinafter referred to as the “Project”) is aligned with the focal area’s first objective: “Promote the demonstration, deployment, and transfer of innovative low-carbon technologies” (CCM-1). The Project is also aligned with the focal area’s fourth objective: “Promote energy efficient, low-carbon transport and urban systems” (CCM-4). The deployment of battery-electric buses under an efficient mass transit system, in a country where electricity is produced mainly with renewable resources, results in significant reductions of GHG emissions and improves local air quality. The Project will encourage an international bus manufacturer to develop a prototype for articulated, battery-electric buses to be demonstrated in the existing Bus Rapid Transit (BRT) system in Bogotá, Colombia (i.e. Transmilenio). The bus manufacturer will finance the development of the bus prototype and a private bus operator of Transmilenio will acquire a fleet of battery-electric buses to be tested and deployed in the BRT system. Colombia is a recognized world leader in the development of BRT systems, making this demonstration and deployment an outcome of global relevance. The project is of an innovative nature, insofar there are currently no battery-electric buses for mass transit in commercial operation in Colombia. Furthermore, there are no prototypes of battery-electric articulated buses anywhere in the world.

#### A.1.2. For projects funded from LDCF/SCCF: the LDCF/SCCF eligibility criteria and priorities:

Not applicable.

#### A.1.3 For projects funded from NPIF, relevant eligibility criteria and priorities of the Fund:

Not applicable.

#### A.2. National strategies and plans or reports and assessments under relevant conventions, if applicable, i.e. NAPAS, NAPs, NBSAPs, national communications, TNAs, NIPs, PRSPs, NPFE, etc.:

The Government of Colombia (GoC), led by the Ministry of Environment and Sustainable Development (MESD), is preparing the Colombian Low-Carbon Development Strategy (“*Estrategia Colombiana de Desarrollo de Bajo Carbono*, ECDBC), which is framed under the national policy document CONPES 3700 (“Institutional strategy for the coordination of policies and actions on climate change in Colombia”, 2011). Since the transport sector is a priority sector under the ECDBC, several scenarios and climate change mitigation measures, including the adoption of electric vehicles, are being assessed and discussed with relevant stakeholders. At a later stage of the ECDBC, a number of measures currently under assessment may eventually be adopted by GoC as Nationally Appropriate Mitigation Actions (NAMAs). The transport sector has also been identified as one of the priority areas for the assessment of technology needs for climate change mitigation in Colombia. However, although there are a number of initiatives related to electric transport in the country, GoC has not yet formally adopted a NAMA on electric mobility. It is therefore not possible at this stage to define whether the activities and outputs from this project could be incorporated in a NAMA. In the event that GoC decides to adopt a NAMA on electric mobility, most likely the activities and outputs from the Project will contribute towards the objectives of that NAMA.

The National Urban Transport Policy (NUTP), adopted in 2002, aims at providing competitive, efficient, affordable, safe, and environmentally sound mobility options for the urban population in Colombia. NUTP calls for the implementation of BRTs and Integrated Mass Transit Systems (“*Sistemas Integrados de Transporte Masivo*”, (SITM)) in large cities with more than 600,000 inhabitants. SITMs, comprising BRT systems, are in operation or in construction in eight large cities in Colombia: Bogotá, Soacha, Barranquilla, Bucaramanga, Cali, Cartagena, Medellín and Pereira, making Colombia a world leader in the innovation and development of sustainable, high-quality and affordable urban mobility measures.

The impact of SITMs and BRTs on climate change mitigation is significant, as they improve the quality of mass transit, lead to a modal-shift from private to public transport, reduce congestion and travel times, and require the rationalization and renovation of urban bus fleets. According to Colombia's Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), SITMs and BRTs in Colombian cities contribute to the reduction of 0.8 million tonnes of carbon dioxide equivalent (t CO<sub>2-eq</sub>) per year. Linking NUTP strategies to advanced, low-carbon vehicle technologies would amplify the policy's effects on GHG emissions, putting mass transit in Colombia on a path to low-carbon sustainable development.

The power system in Colombia is dominated by hydropower generation. In 2011, hydropower contributed with 64% of the installed capacity<sup>6</sup> and with 78% of total power generation<sup>7</sup>. The GoC is committed to further promoting the role of renewable energy -including wind, solar and geothermal power- to maintain a comparatively low-carbon footprint of the country's power sector. In particular, the National Development Plan (2010 – 2014) states that “the National Government will design and implement a national policy to encourage research, innovation and development in solar, wind, geothermal, wave, tidal, hydraulic, and other environmentally sustainable energies, in addition to a national policy aimed at valuing the impact of carbon in different sectors, and to establish incentives and alternatives to reduce the carbon-footprint in the country”. The operation of battery-electric vehicles in Colombia would therefore ensure a much smaller carbon-footprint of the urban transport sector compared to other technologies dependent on fossil-fuels.

The National Development Plan also sets a goal for the adoption of 5,000 clean, advanced-technology vehicles (incl. electric, hybrid and EURO V compliant vehicles). The GoC has established fiscal incentives to promote the adoption of these technologies including the reduction of import duties and the deduction of value-added-tax, the latter pending implementation by the authorities.

## **B. PROJECT OVERVIEW:**

B.1. Describe the baseline project and the problem that it seeks to address:

### **Baseline project**

The baseline project includes investments to renew and increase the fleet of high-capacity buses operating under Bogota's BRT, which comprises approximately 1,400 articulated and bi-articulated buses in trunk lines and 600 buses operating in feeder routes. The BRT system started operational service in December 2000 and has been under continuous expansion since then, with additional trunk lines under construction and in planning stages. The system currently has 100 km of physically segregated bus-lanes along nine trunk lines, 139 elevated bus stations and 76 feeder routes. Transmilenio transports approximately 1.75 million passengers per day, roughly one third of the total trips completed in the city every day. An estimated 2,100 new articulated and bi-articulated buses will enter into service over the next five years. A fraction of these vehicles will replace existing vehicles as part of mandatory fleet-renewal agreements with bus operators; while the remaining will be required in new trunk lines as the BRT system continues to be expanded. These investments are committed by private bus operators to meet the requirements included in their contracts to operate in the BRT system. Contracts to operate in the BRT system are awarded through a competitive process by Transmilenio S.A., a public entity responsible for managing the BRT system. Vehicles operating in the BRT system shall comply with technical specification issued by the Colombian Ministry of Transport and Transmilenio S.A. The prevailing practice among bus operators serving Transmilenio is to purchase and operate diesel buses, since this is a well-known and proven technology.

BRT systems require low investments compared to underground or elevated railways and reduce travel times compared to buses on traditional routes and even private transport, thereby reducing car use and road congestion, and encouraging the use of mass transit. Articulated buses operating in BRTs offer

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<sup>6</sup> 9,180 MW hydro, 4,440 MW coal and gas, 680 MW other technologies.

<sup>7</sup> 45.6 TWh hydro, 7.6 TWh gas, 1.6 TWh coal, 3.8 TWh other technologies.

high-capacity, and lower fuel consumption per-passenger and GHG emissions per passenger·km. Articulated buses in BRT systems represent one of the best conventional transport options and a meaningful measure to reduce GHG emissions from urban transport in developing countries. The adoption of clean, low-carbon technologies by private operators in Transmilenio has a great potential to further decrease the carbon foot-print of the city's transport sector and would have a strong demonstration effect in other cities in developing countries.

- B. 2. [incremental /Additional cost reasoning](#): describe the incremental (GEF Trust Fund/NPIF) or additional (LDCF/SCCF) activities requested for GEF/LDCF/SCCF/NPIF financing and the associated [global environmental benefits](#) (GEF Trust Fund/NPIF) or associated adaptation benefits (LDCF/SCCF) to be delivered by the project:

### **Project rationale**

Battery-electric buses are an emerging technology that could significantly reduce GHG emissions from transport in countries with a large fraction of electricity produced with renewable resources. Unlike conventional alternatives using internal combustion engines, there is limited experience with battery-electric buses operating under commercial conditions. The largest fleets of battery-electric buses are currently deployed in Chinese cities (e.g. Shenzhen) where approximately 300 vehicle of this type operate with a range of over 200 km per charge. The number of battery-electric buses in China is expected to exceed 2,000 units over the next 12 months.

Battery-electric electric buses are not the only technological option for BRTs. Other technologies include diesel-electric hybrid buses, hydrogen fuel cell buses, trolley buses, trams, etc. Of these alternatives, hybrid buses are a practical alternative, and indeed such buses have been tested in Colombia. Hydrogen fuel cell buses are believed not to be a competitive solution mainly because of recent advances in battery technologies. Besides the difficulties of carrying hydrogen on board, there are significant conversion losses in converting hydrogen to electricity, even using the most advanced fuel cells. Thus, from an electric resource standpoint, it is an inefficient technology compared to purely electric transport, including battery electric buses, trolley buses, trams, etc. While trolleybuses and trams are also electric powered, and indeed are lighter, since no batteries are carried on board, they require considerable investments in infrastructure for electric connections overhead (trolleybuses) or rails (trams). Moreover, all buses would need to be replaced by other vehicles. Therefore they cannot be incorporated gradually, especially in an existing, operating BRT system. As a result, the only remaining currently feasible alternatives are hybrid buses and battery-electric buses. Hybrid buses reduce diesel consumption by approximately 30%, but still have tailpipe emissions of particulate matter and other criteria pollutants. Hybrid vehicles have less range limitations; since they have greater autonomy compared to battery-electric buses and can be quickly refueled. Battery electric vehicles have some range limitations and recharging is a slow process, but the technology is making significant improvements. As noted above, battery-electric buses operating in China report autonomies in excess of 200 km, which is adequate for a day's operations. In these conditions, recharging can be a night-time activity, where time to recharge is not that critical and electricity prices are lower. A financial assessment commissioned by the IADB compared the life-cycle costs of diesel, hybrid and battery-electric buses (12 meter long) and concluded that, in Bogota, life-cycle costs of hybrid buses are higher than those of diesel buses, while the life-cycle costs of battery-electric buses are lower than those of diesel buses, despite the higher initial investments.

Since Colombia has a hydro-dominated power system, the deployment of high-capacity, battery-electric buses in Transmilenio would displace GHG emissions from diesel engines. In addition, since battery-electric vehicles have zero tailpipe emissions, replacing diesel buses with battery-electric buses would also improve air-quality in densely populated areas. A number of technology, regulatory, financial and awareness barriers would have to be removed to enable the adoption of this technology by bus operators:

- **Technology barriers:** There are no commercial battery-electric buses meeting the technical specifications of buses operating in the BRT system in Bogotá. All commercially available battery-electric buses are in the category of 12 meters (approx. 80 passengers), while the vehicles operating along Transmilenio's trunk lines fall under the categories of either 18 meters (articulated buses, 160 passengers) or 27 meters (bi-articulated buses, 254 passengers). In addition, there is no practical experience with battery-electric buses under the operational conditions of a high-demand, high-frequency BRT system like Transmilenio. Uncertainty regarding the performance of this technology (e.g. range, energy efficiency, etc.) presents an obstacle for its commercial adoption by bus operators.
- **Regulatory barriers:** Vehicles operating in BRT systems in Colombia shall meet technical specifications issued by the Ministry of Transport and BRT administrators. Compliance with these specifications is verified through a vehicle homologation process that involves also road-testing. In addition, the remuneration-scheme used by BRT administrators to negotiate contracts with bus operators requires verifiable evidence of the operation and maintenance costs of the vehicles to be deployed by operators. In the absence of such evidence, contracts with operators adopting new bus technologies cannot be agreed on.
- **Financial barriers:** The investment cost in battery-electric buses is approximately twice that of conventional diesel buses. In principle, lower operational costs over the lifetime of battery-electric buses would make this technology competitive, but its higher investment costs would remain a prohibitive barrier without adequate financial mechanisms and incentives. The fiscal incentives adopted by GoC remain underutilized (reduction of import duties) or have not been regulated and implemented (deduction of value-added-tax). The details on the financial and economic returns from battery-electric buses are currently being elaborated and options for overcoming the financial barriers are being identified (e.g. leasing schemes, extended warranties, electricity purchasing modalities, etc.)
- **Awareness barriers:** There is little information on battery-electric buses available to bus operators and transport authorities in Colombia. Information on vehicle performance and costs, suppliers, battery and battery-charging technologies, and financing options is not readily accessible. In addition, specialized know-how on the operation, servicing and maintenance of battery-electric vehicles is not available. The potential costs and benefits of this technology have not been adequately assessed, thus preventing authorities from effectively enacting policies and guidelines to promote its adoption (the IADB and GoC are executing a technical cooperation to, inter alia, prepare an assessment of the economic costs and benefits of clean, advanced-vehicle technologies for mass transit in Bogotá).

The proposed Project will address the aforementioned barriers through a coordinated effort by public and private entities to develop and test articulated, battery-electric buses in accordance with the requirements of Bogotá's BRT system. Under the proposed Project, BYD Company Limited (BYD), a world leader in battery technologies and battery-electric vehicles, will develop a prototype for articulated, battery-electric buses, following the specifications set by the Colombian Ministry of Transport and Transmilenio S.A. The work to be carried out by BYD includes several stages, including prototype design and manufacture, as well as tooling for manufacturing the fleet of articulated buses required for this project. These development costs are estimated at USD 20 million. With financial and technical support provided by the IADB, a private bus operator of Transmilenio, Express del Futuro, will invest in a fleet of articulated battery-electric buses (8 units) and in the required battery-charging infrastructure. The investment in the fleet of articulated battery-electric buses is estimated at USD 6.5 million. The GEF contribution will finance the incremental-costs associated to (i) testing the fleet of battery-electric buses, (ii) developing policies, regulations and standards, (iii) building the technical capacities of relevant stakeholders, and (iv) raising awareness and disseminating information on battery-electric vehicle technologies. The test of articulated, battery-electric buses should provide evidence on the performance and operational costs of this technology, and lead to the homologation of these vehicles. Results from the test will be made publicly available, to serve as inputs to decision making by transport and environmental authorities, private bus operators, and the financial sector, among others. It is unlikely that, without the GEF contribution, the private sector would make the substantial investments in developing and testing this technology in Colombia. The GEF contribution will ensure that the

knowledge and capacities generated by the test of battery-electric buses will be publicly available, benefiting authorities, bus operators and other stakeholders in Bogotá and other Colombian cities, therefore leading to the adoption of this technology beyond the immediate scope of the Project. The policies, standards and regulations and the technical capacities to be developed with GEF support will contribute to the adoption of battery-electric vehicles in various applications (e.g. mass transit, taxis, urban logistics, private vehicles, etc.), thus delivering additional environmental and economic benefits. The GEF contribution will enable a favorable policy and regulatory environment, and disseminate the results of the Project, facilitating a transition from technology demonstration to deployment.

### **Project components**

#### **Component 1. Policy development to support a large-scale sector transformation**

Activities under this component will support national and municipal authorities to issue and adopt relevant policies, incentives, regulations and standards necessary to support the large-scale deployment of electric vehicles (e.g. standards for battery and battery-charging technologies, regulations for battery re-use/recycling/disposal, safety standards, etc.). Activities under this component will provide authorities and stakeholders with information on the technical, operational and economic challenges related to the adoption of electric-vehicle technologies and options to address these challenges. The proposed activities will also support the implementation of NUTP by means of preparing policies and guidelines for the integration of advanced-technology vehicles in urban mobility plans and projects.

#### **Component 2. Demonstration and assessment of articulated, battery-electric buses in Bogotá's BRT system**

Under this component, a fleet of battery-electric articulated buses will be tested in Bogotá's BRT system, Transmilenio. The test will follow international best-practices to ensure meaningful and accurate test results that can be used with confidence by decision-makers (e.g. transport authorities, private bus operators, financial institutions, etc.). The test design and protocol are currently under preparation and will be validated with relevant stakeholders. The supporting infrastructure (e.g. battery-charging stations) and testing equipment will also be procured and installed. Test results are expected to answer questions regarding the performance, economics and operational integration of battery-electric buses in the context of BRTs in developing countries. Positive test results and economic evaluation should lay the groundwork for the commercial deployment of this technology in Colombian cities and elsewhere.

#### **Component 3. Design of financial mechanisms for the deployment of battery-electric buses**

Activities under this component will prepare financial assessments and business models for the operation of battery-electric buses. The business models would include a schedule of investments by private bus operators, an identification of financing sources (incl. international climate finance sources) and specific recommendations for the fare scheme and incentives to private bus operators. The component will design financial mechanisms for private bus operators renewing fleets as part of the implementation of SITMs in large Colombian cities, addressing the incremental cost associated to advanced-technology vehicles which remains a prohibitive barrier to their commercial deployment.

#### **Component 4. Training, outreach and communication**

This component will facilitate dialogue, training and build local capacities necessary to adopt advanced-technology vehicles, focusing on national and municipal authorities, private bus operators, automobile industry (incl. service and maintenance companies), utilities, financial institutions and civil society organizations. Activities under this component will make available to stakeholders overviews of available technologies, technical and economic assessments, results from vehicle tests, examples of international standards and regulations, etc. An expected output from this component would be the preparation of a technology road-map for the adoption of electric vehicles in Colombia. In addition, the component will undertake targeted activities to raise awareness, disseminate information and communicate the benefits of this technology to private bus operators, authorities and the public, not only in Colombian cities, but in several Latin-American cities by means of workshops, journal articles, webinars and other networking tools.

### **Implementation arrangements**

The C40 Cities Climate Leadership Group, in partnership with the Clinton Climate Initiative (C40-CCI)



will be the Executing Agency for the Project and will be responsible for its overall coordination, administration and monitoring. A Project Management Unit (PMU) financed with Project resources will be set up by C40-CCI in Bogotá and will have the responsibilities for the day-to-day tasks regarding Project execution and monitoring, including the procurement of goods and services.

A Steering Committee (SC) will provide strategic guidance and overall oversight to the execution of the Project. The GoC, C40-CCI, Transmilenio, Express del Futuro and other project partners will be members of the SC and will meet at least annually to review and discuss the Project progress, agree on annual work-plans and priorities, and decide on matters of strategic relevance. C40-CCI, as part of its supervisory and coordination role, will consolidate inputs and progress reports from Project partners implementing specific activities or components under the Project. Details on the management arrangements and commitments by Project partners (incl. co-financing for Project management activities) will be elaborated during the preparation of the complete project proposal.

### **Global environmental benefits**

An accurate estimation of GHG emissions reductions will only be feasible at a later stage, when information on the performance and the market potential of battery-electric buses will be available. At this stage, the following estimates are available:

<b>Assumptions</b>	
Specific fuel consumption diesel articulated buses (18 m)	60 l/100 km <sup>†</sup>
Diesel fuel emissions factor	2.61 kg CO <sub>2</sub> /l
Diesel bus emissions per km	1.57 kg CO <sub>2</sub> /km
Specific electricity consumption battery-electric buses	2.3 kWh/km <sup>‡</sup>
Grid emissions factor	0.11 kg CO <sub>2</sub> /kWh <sup>*</sup>
Battery-electric emissions per km	0.25 kg CO <sub>2</sub> /km
Annual distance travelled per bus	70,000 km
Bus lifetime	12 years

<sup>†</sup> Average of fuel efficiency values reported by bus operators to Transmilenio S.A. (2006 – 2011).

<sup>‡</sup> Initial estimates by the manufacturer.

<sup>\*</sup> Average emissions factor for the Colombian interconnected system.

On the basis of the assumptions above, an initial estimate of GHG emissions reductions from the substitution of diesel-powered articulated-buses with battery-electric articulated-buses results in approximately 91 t CO<sub>2-eq.</sub> per bus per year. Assuming a fleet size of 10 vehicles and a lifetime of 12 years, direct emissions reductions from the Project are estimated at 11,000 t CO<sub>2-eq.</sub> Contracts for operation and fleet renewal under BRT systems stipulate that bus operators shall retire from service and scrap older vehicles when new vehicles are introduced, therefore reducing any potential increase in GHG emissions from retiring diesel-powered vehicles (i.e. leakage).

At this stage, the uncertainty in estimating indirect GHG emissions reductions is significant. The results from the Project would most likely influence the bus markets beyond the city of Bogotá, including other large Colombian cities and probably also markets in neighboring countries. Accurate information on bus markets beyond Bogotá is not readily available, thus a detailed top-down approach is currently not feasible. Under a conservative bottom-up approach, a replication factor of five would result in indirect GHG emissions reductions equivalent to 55,000 t CO<sub>2-eq.</sub> A replication factor of five (i.e. 50 battery-electric articulated-buses adopted over the 10 years following the Project's end), would imply a market penetration of this technology of less than 5% in Bogotá's market. Larger replication factors are therefore not unlikely. Additional, positive impacts on the adoption of battery-electric vehicles in applications other than articulated buses could also be indirectly attributed to the Project, but their quantification is not feasible at this stage.

Improved estimates of direct and indirect GHG emissions reductions will be completed during the project preparation phase.

B.3. Describe the socioeconomic benefits to be delivered by the Project at the national and local levels, including consideration of gender dimensions, and how these will support the achievement of global environment benefits (GEF Trust Fund/NPIF) or adaptation benefits (LDCF/SCCF). As a background information, read [Mainstreaming Gender at the GEF.](#)":

Co-benefits are a characteristic of transport and urban development projects. There is strong international evidence which suggests that measures that reduce GHG emissions in the transport sector generally have large additional benefits that are not climate related. These co-benefits generally include, for example, reduction of congestion (resulting in time saving, improvement of service reliability and reduction of operating costs), improved air quality (resulting in positive health impacts), and improved safety and security. In addition, sustainable public transport in developing countries delivers substantial benefits to the poor and to women.

The proposed GEF intervention would support NUTP by promoting the introduction of advanced, low-carbon technologies in bus operations. Introducing low-carbon vehicle technologies in the context of NUTP would amplify the policy's effects on GHG emissions reductions and criteria pollutants, in particular particulate matter. Air pollution from mobile sources is a major environmental and public-health problem in most cities, especially large metropolitan areas in developing countries. According to a study by the World Bank completed in 2012, the costs associated with air-pollution (specifically particulate matter) in Colombian cities with over 100,000 inhabitants have been estimated at 1.1% of the country's Gross Domestic Product. The air-quality assessment prepared by the Municipality of Bogotá revealed that heavy-duty vehicles, including mass transit buses, contribute with over 70% of particulate matter emissions in Bogotá. Battery-electric buses have zero on-site air emissions, thus remove a critical source of pollution that represents a risk to citizens' health. The emissions from increased electricity generation would take place at power plants located far from metropolitan areas, although these emissions would remain comparatively small due to the prevalence of hydropower in Colombia's energy matrix.

In addition to the global and local environmental benefits, the proposed project would also contribute to the country's energy security. Due to a combination of factors, including the substitution of gasoline with natural gas, diesel fuel and ethanol, the demand for gasoline has declined from 120,000 barrels per day in 1997, to 74,000 barrels per day in 2011. Over the same period, demand for diesel fuel has increased from 60,000 to 112,000 barrels per day. The combination of these two trends has put the oil refining capacity under pressure, as the industry has struggled to meet the demand for diesel fuel while maintaining the country's relatively high volume of oil exports. The substitution of diesel fuel with electricity would bring a much needed diversification of the energy matrix in the transport sector in Colombia and a relief to the refining capacity available in Colombia.

Although in general terms both men and women benefit from a system of mass transport using low-carbon technology buses, it is important to note that some of the benefits differ between genders. One of the main benefits from the adoption of battery-electric buses is the improvement of air quality due to the reduction in noise and criteria pollutants. Women tend to travel more often by public transport, with multiple stopovers to carry out different activities. Moreover, women are more likely to travel with children. Improvements in air quality shall lead to a reduction in health problems, especially respiratory diseases. Likewise, the availability of a cleaner and more efficient mass transport system leads to an increase in the frequency and overall use of the city's BRT system.

B.4 Indicate risks, including climate change risks that might prevent the project objectives from being achieved, and if possible, propose measures that address these risks to be further developed during the project design:

The description of relevant risks is summarized in the table below:

<b>Risks</b>	<b>Risk probability and impact</b>	<b>Response strategy</b>
Bus prototypes fail to meet the required specifications.	Probability: medium  Impact: high	The Project has engaged and will maintain a permanent dialogue with all relevant authorities and stakeholders (i.e. Ministries of Transport, Environment, Energy and Industry, Municipalities, BRTs' managing entities, private bus operators, utilities, etc.) to ensure that all technical and operational requirements for buses under SITMs and BRTs are addressed in the design and testing of the prototypes.  The bus manufacturer will remain an active Project partner during the tests, ensuring a proper feed-back of the test results to the design and production teams.
High cost of the vehicles discourages bus operators.	Probability: medium  Impact: medium	The Project will include a specific component to elaborate and assess different business models that may prove feasible for the commercial adoption of battery-electric buses (e.g. battery leasing schemes, warranties and maintenance agreements, energy purchasing modalities, incentives, international climate finance, etc.).
Lack of skilled personnel to service and maintain the bus prototypes.	Probability: medium  Impact: medium	The Project will finance specific activities to develop the local capacities to service and maintain electric vehicles, including the batteries. The bus manufacturer will be involved during Project execution and will provide technical support directly and through its local dealership.
Poor coordination among Project partners.	Probability: medium  Impact: high	The Project will adopt explicit measures to mitigate this risk. The Project Manager at PMU will have as a main responsibility ensuring a proper coordination among Project partners. Formal and informal communication and reporting functions by Project partners will be adopted to facilitate the coordination of inputs and activities. Sufficient resources will be allocated to monitoring activities.
Lack of qualified experts to support the Project activities.	Probability: low  Impact: medium	The Project will promote the collaboration with a broad base of expert organizations in Colombia and abroad.

B.5. Identify key stakeholders involved in the project including the private sector, civil society organizations, local and indigenous communities, and their respective roles, as applicable:

**Government of Colombia.** The GoC is a major partner of the proposed Project. The Project supports the implementation of the Government's policies on climate change, air-quality and urban mobility and has therefore the support and active participation from the MoT and the MESD. In addition, the Project proposal has been discussed with the Ministry of Mines and Energy and the Ministry of Industry and Commerce. GoC will have a leading role in the elaboration of policies, guidelines and standards for the adoption of battery-electric vehicles.

**Municipality of Bogotá and Transmilenio S.A.** Transmilenio S.A. is a public entity responsible for the management of the city's SITM and BRT systems. Transmilenio S.A. will participate in the definition and verification of the technical, economic and operational requirements for battery-electric buses operating in the SITP and BRT systems. Since Transmilenio S.A. awards, negotiates and manages contracts with private bus operators, the entity will also have a key role in the elaboration and assessment of business models for the adoption of battery-electric buses. The Municipality of Bogotá will participate in the elaboration of policies for the adoption of electric vehicles in the city.

**Express del Futuro S.A.** Express del Futuro is a private bus operator under Bogotá's SITM and BRT

systems. The company is a leading public transport company in Colombia, with extensive experience testing advanced-technology vehicles. Express del Futuro has participated in programs to test natural gas, hybrid and electric buses. With support from the Project, this operator will acquire the fleet of battery-electric buses and the supporting charging infrastructure to be tested. The company will also play a key role in the elaboration of standards and the assessment of business models for the adoption of battery-electric buses.

**BYD Company Limited (BYD)**. BYD is a major manufacturer of batteries, electronics and automobiles. The company is the world largest supplier of rechargeable batteries, and the largest Chinese auto-manufacturer (450,000 cars sold in 2011). BYD is also a world leader in electric vehicles, particularly in mass transit applications. Approximately 300 units of BYD's 12-meter-long battery-electric buses are now in operation. Under the Project, BYD will design and manufacture a prototype of an articulated battery-electric bus (18 m) to meet the technical requirements for vehicles operating in Bogotá's BRT (development costs are estimated at USD 20 million). BYD is establishing partnerships with local companies to commercialize and service electric vehicles in Colombia. It is expected that these and other local companies will participate in the activities aimed at building local capacities that will be implemented by the Project.

**C40 Cities Climate Leadership Group, in partnership with the Clinton Climate Initiative (C40-CCI)**. C40-CCI is global network of large and engaged cities committed to implementing meaningful and sustainable climate-related policies and programs locally that will help address climate change globally. Among other actions, C40-CCI supports the "C40 Electric Vehicle Network", a collaborative effort by fifteen of the world's largest cities (incl. Bogotá) and vehicle manufacturers to promote the adoption of electric vehicles. C40-CCI has also partnered with the IADB on a program to test and deploy hybrid buses in Colombia, leading to the structuring of a commercial financing scheme that blends resources from the Clean Technology Fund, Colombia's financial institutions and the IADB. C40-CCI has led market studies and technology assessments for low-carbon buses in some Latin American countries. C40-CCI also structured and fostered with the city of Bogotá and other partners an electric taxi pilot project. C40-CCI will be the executing partner for the proposed GEF project, and will take the lead on examining whether the results of the project might offer lessons to other C40 cities in Latin America. The technical expertise, global network, reputation and impartiality of C40-CCI are the main factors taken into account to choose the partnership as the executing partner for the Project. C40-CCI has an existing staff presence in Bogotá prepared to locally manage the program.

**CODENSA**. Codensa is the private utility supplying electricity to, inter alia, the city of Bogotá. Codensa has relevant work on electric vehicles, including its participation in a pilot project on electric taxis in Bogotá. The company is also leading the assessment of the adoption of electric vehicles as a potential NAMA to be presented for consideration by GoC. Codensa will have a relevant role in the design and installation of battery-charging infrastructure, the elaboration of policies and standards, and the design of financial models for electric vehicles.

#### B.6. Outline the coordination with other related initiatives:

The proposed Project will coordinate with and serve as a catalyzer for a number of initiatives on electric vehicles currently under preparation or implementation in Colombia, for example: (i) Express del Futuro and Codensa are preparing the test of a 12 m battery-electric bus, partially financed by a grant from the Colombian Department for Science, Technology and Innovation (Colciencias), (ii) the Municipality of Bogotá, Codensa and C40-CCI are preparing a pilot project for the adoption of 50 battery-electric taxis in Bogotá, (iii) Coca-Cola uses a fleet of 2.5-t battery-electric delivery vans in down-town Bogotá, where larger vehicles are not allowed. Specific modalities of collaboration with these initiatives, including the harmonization of testing protocols, training and information and results sharing, will be elaborated during the preparation of the complete project proposal.

The proposed Project will also coordinate closely with IADB's program on hybrid buses in Colombia, implemented with C40-CCI, ensuring a consistent approach and the complementarity of both initiatives. The MoT, MESD and IADB have had initial contacts with the International Energy Agency's Implementing Agreement on Hybrid and Electric Vehicle Technologies and Programmes (IA-HEV) and a further collaboration could be sought. The Project will also coordinate with other GEF sponsored

initiatives involving electric vehicles (e.g. World Bank's project on "Green Energy Schemes for Low-Carbon City in Shanghai, China", GEF ID 4488).

### **C. DESCRIBE THE GEF AGENCY'S COMPARATIVE ADVANTAGE TO IMPLEMENT THIS PROJECT:**

#### **C.1 Indicate the co-financing amount the GEF agency is bringing to the project:**

The IADB, through the Sustainable Energy and Climate Change Initiative (SECCI), has approved a technical cooperation project on "Market Entry of Electric Buses for Mass Transit in Colombia" (USD 350,000). The technical cooperation, currently under execution, will provide a protocol for testing a fleet of battery-electric buses, a preliminary cost benefit assessment of advanced-technology buses and initial recommendations for the integration of electric buses in mass transit projects in Colombia.

The IADB would also provide an investment grant (USD 1,500,000) to contribute towards the investment costs related to procurement of the fleet of battery-electric buses and battery-charging infrastructure, and to the training of staff participating in the operation and maintenance of the fleet. The Multilateral Investment Fund (MIF), a member of the IADB Group, would provide a technical assistance grant to co-finance the Project's activities on policy development, capacity building and the assessment of business models for the adoption of battery-electric buses.

#### **C.2 How does the project fit into the GEF agency's program (reflected in documents such as UNDAF, CAS, etc.) and staff capacity in the country to follow up project implementation:**

The Ninth General Capital Increase of the IADB (GCI-9) establishes that the Bank will promote sustainable growth in LAC, which includes pursuing global environmental sustainability and addressing the challenges presented by climate change, while ensuring that energy requirements for development are met. It mandates that the Bank improves its capacity to assist the region in its transition to a green economy, including the development of institutional and regulatory frameworks to allow investments in areas such as sustainable transport, renewable energy and energy efficiency. In light of the priority given to this issue under GCI-9, the Bank has committed to a specific annual lending target for climate change, renewable energy and environmental sustainability. The proposed Project is consistent with the objectives of the "IADB Integrated Strategy for Climate Change Adaptation and Mitigation, and Sustainable and Renewable Energy". The integrated strategy guides the Bank's effort to scale-up support for climate change mitigation and adaptation activities in Latin-America and the Caribbean in accordance with its commitments under GCI-9. The integrated strategy calls for enhanced support along five priority intervention lines: (i) strengthening the Bank's knowledge base, (ii) strengthening institutions and private and public sector capacities, (iii) developing instruments to mainstream climate change mitigation and increase resilience in Bank-funded operations, (iv) expanding lending and technical assistance in key sectors, and (v) scaling-up investments, addressing financial gaps and leveraging private sector investments. IADB's "Climate Change Strategy Action Plan", adopted in February 2012, sets priorities and specific actions for implementing the Bank's strategy on climate change over the period 2012 – 2015. The action plan sets the priorities for IADB's engagement on climate change mitigation, focusing on the sectors with the largest contributions to the region's GHG emissions: land use and land-use change, power generation and demand, and transport.


The Bank's Country Strategy for Colombia (2012 - 2014) sets as a priority supporting the implementation of the NUTP, including activities related to the adoption of integrated mass transit systems in large cities and the adoption of low-carbon transport systems.

**PART III: APPROVAL/ENDORSEMENT BY GEF OPERATIONAL FOCAL POINT(S) AND GEF AGENCY(IES)**

**A. RECORD OF ENDORSEMENT OF GEF OPERATIONAL FOCAL POINT (S) ON BEHALF OF THE GOVERNMENT(S):** (Please attach the [Operational Focal Point endorsement letter\(s\)](#) with this template. For SGP, use this [OFP endorsement letter](#)).

NAME	POSITION	MINISTRY	DATE (MM/dd/yyyy)
Alejandra Torres	Head, International Affairs Office	MINISTRY OF ENVIRONMENT AND SUSTAINABLE DEVELOPMENT	10/05/2012

**B. GEF AGENCY(IES) CERTIFICATION**

<b>This request has been prepared in accordance with GEF/LDCF/SCCF/NPIF policies and procedures and meets the GEF/LDCF/SCCF/NPIF criteria for project identification and preparation.</b>					
Agency Coordinator, Agency name	Signature	DATE (MM/dd/yyyy)	Project Contact Person	Telephone	Email Address
Michael Collins, IDB-GEF Coordinator		01/16/13	Francisco Arango	+1 202 - 623 2393	farango@iadb.org