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**TC Document**  
**Market Entry of Electric Buses for Mass Transit in Colombia**  
**CO-T1278**

**I. Basic Information for TC**

- Country/Region: Colombia
- TC Name: Market Entry of Electric Buses for Mass Transit in Colombia
- TC Number: CO-T1278
- Team Leader/Members:
  - Carlos Mojica (INE/TSP) and Francisco Arango (INE/ECC), project co-leaders;
  - Claudio Alatorre (INE/ECC), Paula Castillo (TSP/CCO), Sergio Luis Deambrosi (TSP/CCO), Roberto Esmeral (ECC/CCO), Kevin McTigue (LEG/SGO), project team members
- Date of TC Abstract authorization: 2 November 2011
- Donors providing funding: SECCI ordinary capital fund (SCI)
- Beneficiary: Ministry of Transport, Colombia
- Executing Agency and contact name: Inter-American Development Bank (IDB)
- IDB Funding Requested: USD 350,000
- Local counterpart funding, if any: USD 150,000
- Execution period: 12 months
- Disbursement period: 15 months
- Required start date: 15 December 2011
- Types of consultants: Firms / individual consultants
- Prepared by Unit: joint proposal INE/TSP - INE/ECC
- Unit of Disbursement Responsibility: INE/ECC
- TC Included in Country Strategy: The draft Country Strategy for Colombia (2011 - 2014) sets as a priority supporting the implementation of the country's policy on urban transport, including activities related to the adoption of integrated mass transit systems in large cities. The Country Strategy for Colombia (2007 – 2010) highlights the role of the IDB promoting mass transit, also as a means to improve competitiveness.
- GCI-9 Sector Priority: Climate change, sustainable energy and environmental sustainability

**II. Objectives and Justification of the TC**

**Objective:** The objective of this technical cooperation (TC) is to facilitate and accelerate the adoption of electricity-driven vehicles in the city of Bogota, with a view to reducing the emission of greenhouse gases (GHG) and criteria pollutants, and reducing the country's dependency on hydrocarbon fossil-fuels for transportation. An ancillary objective of this TC is to promote a market for advanced bus technologies in Colombia.

**Justification:** The Government of Colombia (GoC), through the Ministry of Transport (MoT), has requested the IDB its support for the identification of innovative, environmentally-sound vehicle technologies to be deployed in the context of the city's mobility strategy. This strategy includes, inter alia, the implementation of an Integrated Mass Transit System (*Sistema Integrado de Transporte Público* (SITP)), the continuous expansion of Bogota's Bus Rapid Transit (BRT) system, and the design and implementation of a model environmentally- and urbanistically-sound corridor along the "Avenida Séptima", one of the city's main arteries.

The transport sector is one of the fastest growing sources of GHG emissions in Latin-America and the Caribbean (LAC). In Colombia, in 2004, the transport sector contributed with 12%

of the total GHG emissions of the country, and with 33% of the emissions from energy conversion<sup>1</sup>. There are two factors that may allow electricity-driven buses to significantly slow down the growth of GHG emissions from this sector. On the one hand, due to the prevalence of hydropower in Colombia, the electricity in the country is generated with comparatively low GHG emissions. On the other hand, the adoption of BRT systems in Colombia (e.g. Bogota, Bucaramanga, Cali, etc.) has contributed to improving the efficiency, quality and safety of urban transport and reducing the associated GHG emissions. In this context, the deployment and operation of electricity-driven buses, replacing conventional Diesel-powered vehicles, may substantially decrease GHG emissions related to mass transit in Colombian cities. In addition to the global environmental benefits derived from the reduction of GHG emissions, electricity-driven vehicles could also have a significant impact reducing criteria pollutants (e.g. particulate matter, carbon monoxide and nitrogen oxides) which are responsible for serious public health hazards in urban areas. Furthermore, the substitution of Diesel with electricity could have a positive effect on the country's energy security and balance of payments.

This TC will contribute to the removal of awareness, information and technical barriers to the adoption of electricity-driven vehicles in Bogota. It will generate information and evidence regarding the benefits, costs, technical specifications, performance, and the integration into existing transport operations of different electricity-driven bus technologies. The outputs from the TC will inform key decision-makers and stakeholders regarding the challenges and benefits from these innovative technologies, accelerating their adoption in the context of the city's mobility strategy.

The National Development Plan of Colombia (*Plan Nacional de Desarrollo, 2010 – 2014*) stipulates that GoC may continue supporting mass transit systems in large and mid-size cities (including Bogota), as well as mobility plans in smaller municipalities (under 250,000 inhabitants). The plan also indicates that urban-transport projects, financed partially with resources from the national budget, may adopt the fuel with the least real and environmental cost. The proposed TC will provide valuable information to assess the technical and economic feasibility of electricity-driven vehicles in the context of mass transit project in Bogota and other cities in Colombia.

The TC is in line with the goals of the Ninth General Capital Increase (GCI-9), contributing to the sector priority on climate change, sustainable energy and environmental sustainability. Furthermore, the TC is aligned with the priorities and strategic lines of intervention defined in the Bank's "Integrated Strategy for Climate Change Adaptation and Mitigation, and Sustainable and Renewable Energy" (GN-2609-1) that aims at, inter alia, expanding lending and technical assistance in climate change relevant sectors, including sustainable urban transport (p. 20). The draft Country Strategy for Colombia (2011 - 2014) sets as a priority supporting the implementation of the country's policy on urban transport, including activities related to the adoption of integrated mass transit systems in large cities. In this context, the IDB has been supporting technological improvements in Colombia's public transport systems. This TC is closely related to and builds on the early results from IDB's TC RG-T1798 (Hybrid Bus Test Program in Brazil and Colombia) and will complement the outputs on hybrid-bus technologies from this TC with specific insights on electric-vehicle technologies. Together, this TC and the TC RG-T1798 (currently being executed in partnership with the Clinton Climate Foundation), will support the execution of Colombia's investment plan under the Clean Technology Fund (CTF), that includes a component on sustainable transport in Bogota (USD 80 M). While the emphasis of RG-T1798 is the technical demonstration of hybrid-bus technologies in Colombian and Brazilian cities, the proposed TC will elaborate on the economic and financial aspects of this specific technology and expand the scope of technology options

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<sup>1</sup> Instituto de Hidrología, Meteorología y Estudios Ambientales (IDEAM), Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), 2010.

to include externally-fed electric vehicles and battery-driven vehicles. This comprehensive approach should provide an improved background for informed decision-making by public and private stakeholders and build the basis for the commercial deployment of advanced vehicle technologies for mass transit in Colombia. The proposed TC would contribute to the achievement of the proposed target on limiting GHG emissions from mass transit included in the draft Country Strategy.

The outcomes from this TC are expected to build the basis for a proposed program under discussion with GoC and the Government of the United Kingdom of Great Britain and Northern Ireland (GoUK), to promote advanced, clean-vehicle technologies for mass transit in Colombia. The proposed program would include a field-test of battery-driven vehicles on Bogota's BRT and the implementation of a financial and incentive scheme for the commercial deployment of hybrid vehicles in different cities in Colombia. The IDB is supporting GoC to access resources from GoUK's International Climate Fund to prepare and roll-out the proposed program.

### **III. Description of activities/components and budget**

The TC on "Market Entry of Electric Buses for Mass Transit in Colombia" will deliver three main outcomes:

#### **Outcome 1. Financial assessment of advanced, clean technology vehicles under the SITP**

Through the technical cooperation RG-T1798, the IDB, together with the Clinton Foundation and their local partners, have made relevant progress regarding the technical and operational assessment of hybrid bus technologies in Bogota, Curitiba, Rio de Janeiro and Sao Paulo. In this context, the partners have identified the opportunity to build on these early results and elaborate on the financial analysis of advanced, clean technology vehicles, with a view to assess its commercial feasibility and, as appropriate, to design and structure an adequate business model for the adoption of such technologies by private bus operators in Bogota.

**Activity 1.1. Financial assessment of advanced, clean-vehicle technologies.** A study will be commissioned to assess key financial and operative variables regarding the operation of advanced, clean technology vehicles, including, inter alia, fuel and energy performance and costs, infrastructure requirements and related investment costs, operation and maintenance costs, administrative and other associated relevant costs. The study will provide evidence and analyze the main financial indicators such as investment rate of return, net present value and cash flow.

**Activity 1.2. Business model for the adoption of advanced, clean-vehicle technologies.** On the basis of the financial assessment (activity 1.1.), the main elements of a business model for the adoption of advanced, clean technologies by private bus operators will be laid down. The business model would include a schedule of investments, an identification of financing sources (incl. international climate finance sources) and specific recommendations for the fare scheme and incentives to private bus operators under the SITP.

#### **Outcome 2. Assessment of electricity-driven vehicles in the context of the Avenida Séptima corridor**

This outcome will provide an assessment of the feasibility and technical specifications of modern, electricity-driven vehicles to be deployed under operational conditions in the proposed project along the *Avenida Séptima* corridor. The TC is building on the current plans of the City of Bogotá to implement a green corridor with investments in public transportation and non-motorized transport. In particular, the TC will generate concrete recommendations for the development and adoption of technical specifications for the vehicles (electric/hybrid powered) to be operated on this strategic corridor.

**Activity 2.1. Provision of expert advice.** Bus service has traditionally used Diesel and Natural Gas as fuels in Colombia, therefore, there is no existing knowledge base to adopt an electric technology. A panel of experts will advise the national and local governments regarding electricity-driven bus operations. In particular, the panel will cover issues of energy consumption, energy supply, infrastructure, vehicle acquisition, financing, fleet operation and maintenance, in order to gain stakeholder's buy-in.

**Activity 2.2. Development of technical specifications and preliminary engineering.** This activity will provide technical support to the development of technical specifications of electric vehicles for the *Avenida Séptima* corridor. These specifications are crucial elements to prepare any tendering process and represent the output performance measures that will be required from buses operating on the corridor. For instance, elements such as size, consumption, weight, design, capacity and emissions are expected to be known by any bus manufacturer that presents a bus proposal for the corridor. The development of these specifications will require contributions from international experts (technology) and local knowledge (BRT system).

**Activity 2.3. Support to an international bus design contest.** Through this activity, authorities will invite bus manufacturers and other private sector stakeholders to propose optimal vehicle designs to the *Avenida Séptima* corridor. These proposals will adapt the existing electric technologies to the infrastructure and operational requirements of Bogota's BRT. The logistics and prize for the contest, as applicable, will be funded with local budget, while the IDB will provide technical assistance through activities 2.1. and 2.2.

### **Outcome 3. Assessment of retrofitting existing vehicles with battery-driven technologies**

The proposed activities under this outcome will address the benefits and evaluate the costs and barriers to the adoption of battery-driven vehicles in the specific context of the city's BRT. This outcome will inform and support the decision-making in this regard by the different stakeholders (i.e. Transmilenio S.A., private bus operators, utilities and city authorities, etc.).

**Activity 3.1. Overview of state-of-the-art technologies.** This activity will provide an overview of the current state and latest development regarding technologies for battery-driven electric vehicles, in particular, with regard to energy storage and battery charging technologies and best practices. The overview should point at technologies worth pursuing in the context of Transmilenio.

**Activity 3.2. Preparation of a field test of battery-driven vehicles.** A field test of battery-driven vehicles will be designed on the basis of the overview above (activity 3.1.). The preparation of the tests will include the selection of the technologies, the specification of driving cycles, and the definition of the methodology and equipment for the assessment of results. The test design will include specific recommendations regarding the feasibility of retrofitting Diesel-run vehicles that are currently being removed from service in the city's BRT system.

**Activity 3.3. Cost-benefit analysis of battery-driven vehicles.** A preliminary cost-benefit and financial analysis of the adoption of battery-driven vehicles will be carried out, incorporating key aspects of the operation of these technologies. The analysis will include an assessment of key capital expenditures (e.g. vehicles and supporting infrastructure); operations costs and savings (e.g. maintenance, fuel and electricity) and environmental and health benefits (e.g. GHG emissions, population exposure to criteria pollutants).

Results Matrix							
<b>Goal:</b> The TC will ultimately contribute to the achievement of the proposed target on limiting GHG emissions from mass transit included in the draft Country Strategy							
	Unit	Baseline		Target		Expected Completion Date	Data Source
		Value	Year	Planned	Actual		
<b>Outcome 1</b> Number of advanced, clean technologies deemed financially feasible in the context of SITP	Number	0	2011	1		August 2012	Project reports
<b>Output 1.1</b> Number of advanced, clean technologies for which a financial assessment has been completed	Number	0	2011	2		May 2012	Project reports
<b>Output 1.2</b> Number of advanced, clean technologies for which a business model has been completed	Number	0	2011	1		June 2012	Project reports
<b>Outcome 2</b> Number of electric bus fleets that are tendered for <i>Avenida Séptima</i>	Number	0	2011	1		October 2012	Project reports
<b>Output 2.1</b> Number of experts that have provided technical advice	Number	0	2011	4		March 2012	Project reports
<b>Output 2.2</b> Number of electric models for which a technical assessment has been developed	Number	0	2011	1		August 2012	Project reports
<b>Output 2.3</b> Number of bus manufacturers that present proposals to the international bus design contest	Number	0	2011	5		May 2012	Project reports
<b>Outcome 3</b> Number of battery-driven vehicle technologies agreed for field testing by Transmilenio S.A. and IDB	Number	0	2011	1		July 2012	Official communications (e.g. minute, funding proposals, etc.)
<b>Output 3.1</b> Report on the assessment of battery-driven bus technologies completed	Number	0	2011	1		April 2012	Project reports
<b>Output 3.2</b> Plan for field testing of battery-driven vehicles completed	Number	0	2011	1		June 2012	Project reports
<b>Output 3.3</b> Report on cost-benefit assessment of battery-driven bus technologies completed	Number	0	2011	1		June 2012	Project reports

Indicative Budget					
	Project Cost – IDB Financing [USD]			Counterpart resources	Total funding
	Consulting services.	Consultant's travel	Total request		
<b>Outcome 1</b> Financial assessment of advanced, clean technology vehicles under the SITP	100,000	5,000	105,000	-	105,000
<b>Activity 1.1.</b> Financial assessment of advanced, clean-vehicle technologies	40,000	-	40,000	-	40,000
<b>Activity 1.2.</b> Business model for the adoption of advanced, clean-vehicle technologies	60,000	5,000	65,000	-	65,000
<b>Outcome 2</b> Assessment of electricity-driven vehicles in the context of the <i>Avenida Séptima</i> corridor	125,000	10,000	135,000	150,000	285,000
<b>Activity 2.1.</b> Provision of expert advice: workshops and field inspection	40,000	10,000	50,000	-	50,000
<b>Activity 2.2.</b> Development of technical specifications and preliminary engineering	85,000	-	85,000	-	85,000
<b>Activity 2.3.</b> Support to an international bus design contest	-	-	-	150,000	150,000
<b>Outcome 3</b> Assessment of battery-driven electric vehicles	75,000	5,000	80,000	-	80,000
<b>Activity 3.1.</b> Overview of state-of-the-art technologies	10,000	-	10,000	-	10,000
<b>Activity 3.2.</b> Preparation of a field test of battery-driven vehicles	50,000	5,000	55,000	-	55,000
<b>Activity 3.3.</b> Cost-benefit analysis of battery-driven vehicles	15,000	-	15,000	-	15,000
<b>Sub-total</b>	<b>300,000</b>	<b>20,000</b>	<b>320,000</b>	<b>150,000</b>	<b>470,000</b>
Execution, monitoring and evaluation			30,000	-	30,000
<b>Total</b>			<b>350,000</b>	<b>150,000</b>	<b>500,000</b>
Approximate value of in-kind counterpart				-	-

The IDB, through the Transport Division (INE/TSP) and the Sustainable Energy and Climate Change Unit (INE/ECC), will be the executing agency for this TC. Focal point in the Colombian country office will be Sergio Luis Deambrosi (TSP/CCO). The project team will have the responsibility of supervising and monitoring the execution of the TC. The project team will be responsible for the selection, contracting and supervision of external consultants, as well as for the procurement of other services in accordance with the applicable IDB procedures. Acquisitions and contracting will be carried out in accordance with the Policies for the Selection and Contracting of Consultants financed by the IDB (GN-2350-9). No exceptions to these policies are foreseen. Throughout the duration of the activities, input and feedback will be sought from the client and project partners, including the Ministry of Transport, the Municipality of Bogota, Transmilenio S.A., Clinton Climate Initiative, etc. All products from the TC will be subject to quality review by the Bank's project-team and by anonymous peer reviewers (included in the monitoring budget). Training or monitoring activities, including regular inspection visits, requested by the Ministry of Transport as part of this TC to IDB staff team members will be shared as costs to supervise the execution of the TC by INE/TSP and INE/ECC.

#### IV. Executing agency and execution structure

The Ministry of Transport, in its communication to the IDB (IDB-Docs No. [36424989](#)), requested the Bank to execute the proposed TC. The proposed activities will demand the execution of highly specialized consultancies. The beneficiary requires the Bank's support to appropriately select and supervise the required experts. Given the high degree of specialization of the work that is involved, the execution of the TC will benefit from the Bank's regional experience and technical knowledge. In this context, the Ministry of Transport has requested the IDB to directly execute the proposed TC.

The adoption of advanced-vehicle technologies in the context of mass transit systems in Colombia is a country-led initiative. The IDB is supporting this initiative through various efforts (CTF, RG-T1798, etc.), including the proposed TC. Local authorities, in particular the Municipality of Bogota and Transmilenio S.A., are keen to explore new technologies that may magnify the economic and environmental benefits from the city's model transport initiatives like Transmilenio, SITP and the proposed corridor along *Avenida Septima*. Throughout the duration of the activities, input and feedback will be sought from the client and project partners, including the Ministry of Transport, the Municipality of Bogota, Transmilenio S.A., the Clinton Climate Initiative, etc.

#### V. Major issues

**Technology risk.** There is an inherent risk associated to the technologies proposed under this TC due to their innovative nature. It is possible that no fully-adequate technologies can be identified for the proposed applications, that the technologies identified may result too costly to be adopted on a commercial scale, or that no provider is in a position to offer the required technology in the conditions required by the city of Bogota. The technical cooperation RG-T1798 and this proposed TC are designed with the explicit intention to address these risks gradually, with a view to minimizing the risk of financial losses to the IDB, to the city of Bogota and to private operators. To the extent that these risks can be adequately addressed, it is expected that these technologies will successfully complete the initial stages of technology development and adoption and that a market for these technologies will eventually mature.

#### VI. Exceptions to Bank policy

No exceptions to the Bank's policies have been identified.

#### VII. Environmental and Social Strategy

The proposed TC doesn't include any activity that may generate negative environmental and/or social impacts, on the contrary it is expected that the outputs would lead to positive environmental impacts. Following the Safeguard Policy Filter Report and Safeguard Classification Form (IDB-Docs No. [36467871](#)) this TC has been tentatively classified under category "C".

#### Annexes

**Annex A.** Request from the Ministry of Transport (IDB-Docs No. [36424989](#))

**Annex B.** Terms of reference

- i. Terms of reference: the financial assessment of advanced, clean technology vehicles [36568874](#)
- ii. Terms of reference: the development of technical specifications [36568864](#)
- iii. Terms of reference: the assessment of battery-driven electric vehicles [36568834](#)

## **Terms of Reference**

### **CO-T1278**

#### **Market Entry of Electric Buses for Mass Transit in Colombia**

#### **Financial assessment of advanced, clean- vehicle technologies under the Integrated Public Transport System in Bogota**

##### **I. BACKGROUND AND JUSTIFICATION**

- 1.1. The transport sector in Colombia contributed with 12% of the country's overall greenhouse gas (GHG) emissions in 2004, and with 33% of all energy related GHG emissions. Moreover, the share of GHG emissions from transportation is increasing, as emissions from this sector are growing at an increasingly faster rate. In order to facilitate Colombia's transition to a path of low-carbon, sustainable development, it is critical to address GHG emissions from the transport sector.
- 1.2. The Inter-American Development Bank (IDB) is supporting the Government of Colombia (GoC) to identify, assess and adopt advanced, clean- technology vehicles in the context of Bogota's urban mobility strategy. The collaboration between the IDB and GoC covers a broad number of technological alternatives, including hybrid buses, externally-fed electric vehicles (trolley-buses) and battery-driven buses.
- 1.3. The IDB, together with the Clinton Foundation and their local partners, have made relevant progress regarding the technical and operational assessment of hybrid bus technologies in Bogota, Curitiba, Rio de Janeiro and Sao Paulo. Field tests of hybrid buses in Bogota are scheduled during late-2011 and they are expected to provide further details on the technical and operational requirements for the adoption of this technology under the city's urban mobility strategy.
- 1.4. Building on this experience, the IDB and GoC have agreed to expand the scope of their collaboration and support the adoption of clean technology vehicles by means of a financial assessment of advanced, clean-vehicle technologies that could potentially be deployed under Bogota's Integrated Public Transport System (SITP). As part of this phase of the collaboration, it is expected that the study will provide evidence and analyze the main financial indicators involved in the adoption and operation of clean technology buses as well as an adequate business model and incentive structure for the adoption of such technologies by private bus operators in Bogota.

- 1.5. The adoption of advanced, clean-vehicle technologies can significantly slow down the growth of GHG emissions from the transport sector in Colombia by means of vehicle fuel switch to less intensive fossil fuels, or to renewable fuels or energy. Moreover, the adoption of the Bus Rapid Transit (BRT) system in Bogotá and the further implementation of the Integrated Public Transport System (SITP) contributes to the improvement of the efficiency, quality and safety of urban transport and to the reduction of associated GHG emissions. In this context, the financial assessment, business model and incentive structure design for the deployment and operation of advanced, clean-vehicle technologies will enable local authorities to take the appropriate measures to foster its adoption by the private vehicle operators and henceforth contribute to substantially decrease GHG emissions related to mass transit in Bogotá.
- 1.6. In addition to the global environmental benefits derived from the reduction of GHG emissions, advanced clean-vehicle technologies could also have a significant impact reducing criteria pollutants (e.g. particulate matter, carbon monoxide and nitrogen oxides) which are responsible for serious public health hazards in urban areas.

## **II. OBJECTIVES**

- 2.1. The objective of this consultancy is to support the IDB and GoC with the identification and financial assessment of advanced, clean-vehicle technologies including the design of a business model and incentive structure to enhance the adoption of these technologies by the private bus operators under Bogotá's SITP.

## **III. ACTIVITIES**

- 3.1. **Activity 1. Overview of state-of-the-art technologies.** The consultants will prepare a short document presenting an overview of current advanced, clean-vehicle technologies with an emphasis on urban buses compatible with the operational structure of the SITP. The overview should describe recent developments regarding available technologies, list technology providers and summarize relevant examples of their deployment and incentive structure utilized by local governments and financial institutions to foster its adoption.
- 3.2. **Activity 2. Market analysis.** The consultants will prepare a preliminary market analysis for each technology that includes elements such as market size, trends, growth rate, opportunity and industry cost structure. The analysis should include aspects such as the local demand for each technology and the actual supply of financial services and other incentives for the purchase and operation of advanced, clean-technology buses.

- 3.3. Activity 3. Technology assessment.** The consultants will prepare a report that analyses key financial and operative variables regarding the operation of advanced, clean-technology vehicles, including, inter alia, fuel and energy performance and costs, infrastructure requirements and related investment costs, operation and maintenance costs, administrative and other associated relevant costs.
- 3.4. Activity 4. Cash flow and sensitivity analysis.** The consultants will elaborate a cash flow analysis for the private bus operator taking in account the life-cycle costs for each technology and the relevant contractual specifications under the SITP. A sensitivity analysis will also be carried out taking into account fluctuations in the most relevant variables.
- 3.5. Activity 5. Business model.** On the basis of the financial assessment (activities 2, 3 and 4), the consultants will provide the main elements of a business model for the adoption of advanced, clean-technologies by private bus operators. The business model will include a schedule of investments and identification of financing sources (incl. international climate finance sources).
- 3.6. Activity 6. Incentive structure.** Based on the market analysis (activity 2), as well as on the business model (activity 5), the consultants will propose alternatives for the structuring of incentives for the deployment of advanced, clean-technology buses taking in account private and international climate finance sources.

#### **IV. CHARACTERISTICS OF THE CONSULTING SERVICES**

- 4.1. The consulting services should meet the following requirements:**
- a. **Type:** Consulting firm of one of the IDB's member countries.
  - b. **Time frame:** The activities under these terms of reference should be completed within three months, from the starting date.
  - c. **Place of work:** Home-based with at least one mission to Bogota, Colombia.
  - d. **Qualifications:** The consultant's team should be lead by a transport specialist, with extensive experience in financial assessment of modern vehicle technologies, in particular technologies for mass transit. The consultant's team should also include one transport specialist with extensive knowledge of BRT systems and a finance expert.

The consultant team should have at least the following experience:

**Project coordinator:**

- At least 10 year of demonstrated professional experience leading teams professional experience in the financial evaluation of urban transport systems.

**Transport expert:**

- At least 5 years of demonstrated professional experience in transport, preferably in Latin American countries.

Financial expert:

- At least 5 years of demonstrated professional experience in economic and financial analysis of mass transit investments and operations.

The consulting firm may propose additional staff as part of the team if deemed necessary and not exceeding the suggested budget for the consultancy.

## V. REPORTS AND PAYMENTS

5.1. The consultant will prepare and submit three reports:

- a. **Overview and market analysis of advanced, clean-technology buses.** The report (approx. 40 – 50 pages) will summarize the results from activities one and two above. The report should be prepared in English and be submitted within 30 calendar days from the signature of the contract.
- b. **Technology and cash flow analysis of advanced, clean-technology buses.** The report should present the results from activity three and four above. The report should be elaborated with information provided by the private bus operators as well as the local authorities (Transmilenio S.A.). The report should be prepared in English and be submitted within 60 calendar days from the signature of the contract.
- c. **Business model and incentive structure for the deployment of advanced, clean-technology buses.** The report should present the results from activities five and six above. The report should be prepared in English and be submitted within 90 calendar days from the signature of the contract.

5.2. Payments for the consulting services will be specified in the contract and will be made as follows:

- a. 25% at contract signature;
- b. 25% upon approval of the report on the overview and market analysis of advanced, clean- technology buses;
- c. 25% upon approval of the report on the technology and cash flow analysis of advanced, clean- technology buses;
- d. 25% upon approval of the report on the business model and incentive structure for the deployment of advanced clean- technology buses.

5.3. The estimated budget for this consultancy is USD 105,000. This amount includes all costs and payments related to the deliverables and to the mission(s) to Bogota (incl. travel, lodging and all other expenses).

## VI. COORDINATION

- VII. The Transport Division (INE/TSP) of the IDB will have the technical responsibility of the execution of this contract as well as the approval of the products prepared by the consulting firms. In representation of the IDB, the technical coordination for this consultancy rests with Mr. Carlos Mojica, Transport Specialist INE/TSP (e-mail: cmojica@iadb.org) and with Mr. Francisco Arango, Climate Change Specialist with the Sustainable Energy and Climate Change Unit of the IDB (INE/ECC), (e-mail: farango@iadb.org).

## **Terms of Reference**

### **CO-T1278**

#### **Market Entry of Electric Buses for Mass Transit in Colombia**

#### **Development of technical specifications and test protocol for the *Avenida Séptima* transit vehicles**

##### **I. BACKGROUND AND JUSTIFICATION**

- 1.1. The transport sector in Colombia contributed with 12% of the country's overall greenhouse gas (GHG) emissions in 2004, and with 33% of all energy related GHG emissions. Moreover, the share of GHG emissions from transportation is increasing, as emissions from this sector are growing at an increasingly faster rate. In order to facilitate Colombia's transition to a path of low-carbon, sustainable development, it is critical to address GHG emissions from the transport sector.
- 1.2. The Inter-American Development Bank (IDB) is supporting the Government of Colombia (GoC) to identify, assess and adopt advanced, clean- technology vehicles in the context of Bogota's urban mobility strategy. The collaboration between the IDB and GoC covers a broad number of technological alternatives, including hybrid buses, externally-fed electric vehicles (trolley-buses) and battery-driven buses.
- 1.3. The IDB, together with the Clinton Foundation and their local partners, have made relevant progress regarding the technical and operational assessment of hybrid bus technologies in Bogota, Curitiba, Rio de Janeiro and Sao Paulo. Field tests of hybrid buses in Bogota are scheduled during late-2011 and they are expected to provide further details on the technical and operational requirements for the adoption of this technology under the city's urban mobility strategy.
- 1.4. Building on this experience, the IDB and GoC have agreed to expand the scope of their collaboration and conduct field tests of battery-driven bus technologies that could potentially be deployed under Bogota's bus rapid transit (BRT) system, Transmilenio. As part of this phase of the collaboration, it is expected that a number of Diesel-run articulated buses could be retrofitted with state-of-the-art battery-driven electricity propulsion systems and be tested under operational conditions in Bogota.

- 1.5. There are two factors that may allow electricity-driven buses to significantly slow down the growth of GHG emissions from the transport sector in Colombia. On the one hand, due to the prevalence of hydropower in Colombia, the electricity in the country is generated with comparatively low GHG emissions. On the other hand, the adoption of BRT systems in various cities in Colombia has contributed to the improvement of the efficiency, quality and safety of urban transport and to the reduction of associated GHG emissions. In this context, the deployment and operation of electricity-driven buses, replacing conventional Diesel-powered vehicles, may substantially decrease GHG emissions related to mass transit in Colombian cities.
- 1.6. In addition to the global environmental benefits derived from the reduction of GHG emissions, electricity-driven vehicles could also have a significant impact reducing criteria pollutants (e.g. particulate matter, carbon monoxide and nitrogen oxides) which are responsible for serious public health hazards in urban areas. Furthermore, the substitution of Diesel with electricity could have a positive effect on the country's energy security and balance of payments.

## **II. OBJECTIVES**

- 2.1 The objective of this consultancy is to support the IDB and GoC with the preparation of the desired technical specifications for the *Avenida Séptima* bus design contest.

## **III. ACTIVITIES**

- 3.1 The consultant will prepare technical specifications for the public transport vehicles that will operate on the mass transit corridor along *Avenida Séptima*. The exact requirements in terms of capacity will be provided as an input from the operational designs. However, the consultant will develop the following activities:
- a. Analyze the physical requirements of the Transmilenio system in terms of: vertical distance at boarding stations, road geometrical design (horizontal and vertical curves), interchange terminals, garages and depots and any other that the consultant considers.
  - b. Analyze the operational requirements of the Transmilenio system at *Avenida Séptima* including: passenger capacity, average speeds, fueling cycles and any other that the consultant considers.
  - c. Explore the market of bus manufacturers across different technologies (e.g. compressed natural gas, hybrid, electric (battery-driven and externally-fed vehicles)). Analyze the technical specifications of buses and technologies that meet the physical and operational requirements of the Transmilenio system at *Avenida Séptima*.

3.2 Develop the following technical specifications (based on the current state of the art) for public transport vehicles in the *Avenida Séptima* corridor:

- a) Energy consumption standards (gl/km, kw/km)
- b) Autonomy (maximum distance before refueling/recharging)
- c) Passenger capacity (seated and standing)
- d) Guaranteed life cycle time (in years)
- e) Exterior noise levels
- f) Interior noise levels
- g) Percentage of recyclable components
- h) Other that the consultant proposes

#### **IV. CHARACTERISTICS OF THE CONSULTING SERVICES**

4.1. The consulting services should meet the following requirements:

- a) **Type:** Consulting firm
- b) **Time frame:** The activities under this terms of reference should be completed within two months, from the starting date.
- c) **Place of work:** Bogota, Colombia.
- d) **Qualifications:** The consultant should be a transport professional with at least 5 years in transport engineering, with experience in planning and/or designing and/or operating bus systems, in particular technologies for mass transit.

#### **V. REPORTS AND PAYMENTS**

- 5.1. The consultant will prepare and submit one report at the end of the contract. This report must be approved by the Ministry of Transport, Transmilenio S.A and the IDB team
- 5.2. Payments for the consulting services will be specified in the contract and will be made based on a lump-sum of US\$ 85,000.

#### **VI. COORDINATION**

- 6.1. The Transport Division (INE/TSP) of the IDB will have the technical responsibility of the execution of this contract as well as the approval of the products prepared by the consulting firms. In representation of the IDB, the technical coordination for this consultancy rests with Mr. Carlos Mojica, Transport Specialist INE/TSP (e-mail: cmojica@iadb.org) and with Mr. Francisco Arango, Climate Change Specialist with the Sustainable Energy and Climate Change Unit of the IDB (INE/ECC), (e-mail: farango@iadb.org).

## **Terms of Reference**

### **CO-T1278**

#### **Market Entry of Electric Buses for Mass Transit in Colombia**

##### **Test of battery-driven buses for bus rapid transit in Bogota**

### **I. BACKGROUND AND JUSTIFICATION**

- 1.1. The transport sector in Colombia contributed with 12% of the country's overall greenhouse gas (GHG) emissions in 2004, and with 33% of all energy related GHG emissions. Moreover, the share of GHG emissions from transportation is increasing, as emissions from this sector are growing at an increasingly faster rate. In order to facilitate Colombia's transition to a path of low-carbon, sustainable development, it is critical to address GHG emissions from the transport sector.
- 1.2. The Inter-American Development Bank (IDB) is supporting the Government of Colombia (GoC) to identify, assess and adopt advanced, clean- technology vehicles in the context of Bogota's urban mobility strategy. The collaboration between the IDB and GoC covers a broad number of technological alternatives, including hybrid buses, externally-fed electric vehicles (trolley-buses) and battery-driven buses.
- 1.3. The IDB, together with the Clinton Foundation and their local partners, have made relevant progress regarding the technical and operational assessment of hybrid bus technologies in Bogota, Curitiba, Rio de Janeiro and Sao Paulo. Field tests of hybrid buses in Bogota are scheduled during late-2011 and they are expected to provide further details on the technical and operational requirements for the adoption of this technology under the city's urban mobility strategy.
- 1.4. Building on this experience, the IDB and GoC have agreed to expand the scope of their collaboration and conduct field tests of battery-driven bus technologies that could potentially be deployed under Bogota's bus rapid transit (BRT) system, Transmilenio. As part of this phase of the collaboration, it is expected that a number of Diesel-run articulated buses could be retrofitted with state-of-the-art battery-driven electricity propulsion systems and be tested under operational conditions in Bogota.

- 1.5. There are two factors that may allow electricity-driven buses to significantly slow down the growth of GHG emissions from the transport sector in Colombia. On the one hand, due to the prevalence of hydropower in Colombia, the electricity in the country is generated with comparatively low GHG emissions. On the other hand, the adoption of BRT systems in various cities in Colombia has contributed to the improvement of the efficiency, quality and safety of urban transport and to the reduction of associated GHG emissions. In this context, the deployment and operation of electricity-driven buses, replacing conventional Diesel-powered vehicles, may substantially decrease GHG emissions related to mass transit in Colombian cities.
- 1.6. In addition to the global environmental benefits derived from the reduction of GHG emissions, electricity-driven vehicles could also have a significant impact reducing criteria pollutants (e.g. particulate matter, carbon monoxide and nitrogen oxides) which are responsible for serious public health hazards in urban areas. Furthermore, the substitution of Diesel with electricity could have a positive effect on the country's energy security and balance of payments.

## **II. OBJECTIVES**

- 2.1. The objective of this consultancy is to support the IDB and GoC with the identification and assessment of battery-driven electric vehicles technologies and with the preparation of a field test of such technologies in Bogota.

## **III. ACTIVITIES**

- 3.1. **Activity 1. Overview of state-of-the-art technologies.** The consultants will prepare a short document presenting an overview of current technologies for battery-driven electric vehicles with an emphasis on applications for large urban buses (e.g. 54 ft articulated buses). The overview should describe recent developments regarding battery and propulsion-system technologies, list technology providers and summarize relevant examples of prototypes' testing and commercial applications of such technologies, as applicable.
- 3.2. **Activity 2. Preliminary cost-benefit analysis of battery-driven vehicles.** The consultants will prepare a preliminary cost-benefit analysis of battery-driven vehicles operating in the context of Bogota's BRT system. The draft analysis should provide estimates of key capital expenditures (e.g. vehicles and supporting infrastructure), operations costs and savings (e.g. maintenance, fuel and electricity) and environmental and health benefits (e.g. GHG emissions, population exposure to criteria pollutants). The preliminary analysis should compare the alternative of battery-driven vehicles with a business-as-usual alternative relying on conventional Diesel-run vehicles.

- 3.3. **Activity 3. Preparation of a field test of battery-driven vehicles.** The consultants should propose and design a field test of battery-driven vehicles on the basis of retrofitting articulated Diesel-run buses (54 ft) used on the corridors of Bogota's BRT system. The preparation of the tests will include recommendations on relevant technologies, the specification of driving cycles, and the definition of the methodology and equipment required for the assessment of results. The test design will include specific recommendations regarding the technical feasibility of retrofitting Diesel-run vehicles that are currently being removed from service in the city's BRT system.

#### IV. CHARACTERISTICS OF THE CONSULTING SERVICES

- 4.1. The consulting services should meet the following requirements:

- a. **Type:** Consulting firm of one of the IDB's member countries.
- b. **Time frame:** The activities under this terms of reference should be completed within three months, from the starting date.
- c. **Place of work:** Home-based with at least one mission to Bogota, Colombia.
- d. **Qualifications:** The consultant's team should be lead by a transport specialist, with extensive experience designing and performing tests of modern vehicle technologies, in particular technologies for mass transit. The consultant's team should also include one transport specialist with extensive knowledge of BRT systems.

The consultant team should have at least the following experience:

Project coordinator:

- At least 10 year of demonstrated professional experience leading teams designing and performing tests of modern vehicle technologies. Experience testing electric-vehicle technologies is highly desirable.

Transport specialist

- At least 5 years of demonstrated professional experience in the design and evaluation of BRT systems.

The consulting firm may propose additional staff as part of the team if deemed necessary and not exceeding the suggested budget for the consultancy.

#### V. REPORTS AND PAYMENTS

- 5.1. The consultant will prepare and submit two reports:

- a. **Overview and assessment of battery-driven technologies.** The report (approx. 40 – 50 pages) will summarize the results from activities one and two above. The report should be prepared in English and be submitted within 30 calendar days from the signature of the contract.

- b. **Design of a field test of battery-driven vehicles.** The report should present the results from activity three above. The report should specify and elaborate on the technical specification of the field test of battery-driven vehicles, the methodology and equipment required for the assessment of results and present an estimation of the costs associated to the test. The report should be prepared in English and be submitted within 60 calendar days from the signature of the contract.

5.2. Payments for the consulting services will be specified in the contract and will be made as follows:

- a. 30% at contract signature;
- b. 30% upon approval of the report on the overview and assessment of battery-driven technologies;
- c. 40% upon approval of report on the design of a field test of battery-driven vehicles.

5.3. The estimated budget for this consultancy is USD 80,000. This amount includes all costs and payments related to the deliverables and to the mission(s) to Bogota (incl. travel, lodging and all other expenses).

## **VI. COORDINATION**

6.1. The Sustainable Energy and Climate Change Unit (INE/ECC) of the IDB will have the technical responsibility of the execution of this contract as well as the approval of the products prepared by the consulting firms. In representation of the IDB, the technical coordination for this consultancy rests with Mr. Carlos Mojica, Transport Specialist with the Transport Division of the IDB (e-mail: cmojica@iadb.org) and with Mr. Francisco Arango, Climate Change Specialist INE/ECC, (e-mail: farango@iadb.org).

# 36513839

## PROCUREMENT PLAN

<b>Country:</b>	<b>COLOMBIA</b>
<b>Executing agency:</b>	Inter-American Development Bank
<b>Project:</b>	Market Entry of Electric Buses for Mass Transit in Colombia
<b>Project and loan contract numbers:</b>	CO-T1278
<b>Brief description of the project's objectives and components:</b>	<p>The objective of this TC is to facilitate and accelerate the adoption of electricity-driven vehicles in the city of Bogota, with a view to reducing the emission of greenhouse gases (GHG) and criteria pollutants, and reducing the country's dependency on hydrocarbon fossil-fuels for transportation. An ancillary objective of this TC is to promote a market for advanced bus technologies in Colombia.</p> <p>Component 1: Financial assessment of advanced, clean technology vehicles under the SITP.</p> <p>Component 2: Assessment of electricity-driven vehicles in the context of the <i>Avenida Séptima</i> corridor.</p> <p>Component 3: Assessment of retrofitting existing vehicles with battery-driven technologies.</p>
<b>Estimated date of project approval:</b>	December 15, 2011
<b>Estimated date of signature of the loan contract:</b>	N/A
<b>Estimated date of the final disbursement:</b>	February, 2013

Description of the contract	Estimated cost of Procurement (US\$)	Procurement method <sup>1</sup>	Source of financing and percentage		Status
			IDB %	Local/other %	
Consulting Firm	105,000.00	QBS	100	-	Pending
Individual Consultant	50,000.00	IICC	100	-	Pending
Consulting Firm	85,000.00	QBS	100	-	Pending
Consulting Firm	80,000.00	QBS	100	-	Pending
Execution, monitoring and evaluation	30,000.00	Bank Policies	100	-	Pending

<sup>1</sup> **Consulting Firms:** QCBS: Quality- and cost-based selection QBS: Quality-based selection FBS: Selection under a fixed budget; LCS: Least-cost selection; CQS: Selection based on the consultants' qualifications; SSS: Single-source selection. **Individual Consultants:** NICQ: National Individual Consultant Selection based on Qualifications; IICC: International Individual Consultant selection based on Qualifications.

## SAFEGUARD POLICY FILTER REPORT

This Report provides guidance for project teams on safeguard policy triggers and should be attached as an annex to the PP (or equivalent) together with the Safeguard Screening Form, and sent to ESR.

1. Save as a Word document. 2. Enter additional information in the spaces provided, where applicable. 3. Save new changes.

<b>PROJECT DETAILS</b>	<b>IDB Sector</b>	ENVIRONMENT AND NATURAL DISASTERS-AIR POLLUTION CTRL & CLIMATE CHANGE
	<b>Type of Operation</b>	Technical Cooperation
	<b>Additional Operation Details</b>	
	<b>Investment Checklist</b>	Generic Checklist
	<b>Team Leader</b>	Arango, Francisco (FARANGO@iadb.org)
	<b>Project Title</b>	Market Entry of Electric Buses for Mass Transit in Colombia
	<b>Project Number</b>	CO-T1278
	<b>Safeguard Screening Assessor(s)</b>	Arango, Francisco (FARANGO@iadb.org)
	<b>Assessment Date</b>	2011-10-14
	<b>Additional Comments</b>	

<b>SAFEGUARD POLICY FILTER RESULTS</b>	<b>Type of Operation</b>	Technical Cooperation	
	<b>Safeguard Policy Items Identified (Yes)</b>	The Bank will make available to the public the relevant Project documents.	(B.01) Access to Information Policy– OP-102
		The operation is in compliance with environmental, specific women's rights, gender, and indigenous laws and regulations of the country where the operation is being implemented	(B.02)

		(including national obligations established under ratified Multilateral Environmental Agreements).	
		The operation (including associated facilities) is screened and classified according to their potential environmental impacts.	(B.03)
		If a Technical Cooperation, the operation is associated with the design and/or implementation of a major investment loan in infrastructure.	(B.04)
		Any part of the investment or component(s) is being co-financed.	(B.15)
		Suitable safeguard provisions for procurement of goods and services in Bank financed projects may be incorporated into project-specific loan agreements, operating regulations and bidding documents, as appropriate, to ensure environmentally responsible procurement.	(B.17)
	<b>Potential Safeguard Policy Items(?)</b>	No potential issues identified	
	<b>Recommended Action:</b>	Operation has triggered 1 or more Policy Directives; please refer to appropriate Directive(s). Complete Project Classification Tool. Submit Safeguard Policy Filter Report, PP (or equivalent) and Safeguard Screening Form to ESR.	

	<b>Additional Comments:</b>	
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<b>ASSESSOR DETAILS</b>	<b>Name of person who completed screening:</b>	Arango, Francisco (FARANGO@iadb.org)
	<b>Title:</b>	
	<b>Date:</b>	2011-10-14

## SAFEGUARD SCREENING FORM

This Report provides a summary of the project classification process and is consistent with Safeguard Screening Form requirements. The printed Report should be attached as an annex to the PP (or equivalent) and sent to ESR.

1. Save as a Word document. 2. Enter additional information in the spaces provided, where applicable. 3. Save new changes.

<b>PROJECT DETAILS</b>	<b>IDB Sector</b>	ENVIRONMENT AND NATURAL DISASTERS-AIR POLLUTION CTRL & CLIMATE CHANGE
	<b>Type of Operation</b>	Technical Cooperation
	<b>Additional Operation Details</b>	
	<b>Country</b>	COLOMBIA
	<b>Project Status</b>	
	<b>Investment Checklist</b>	Generic Checklist
	<b>Team Leader</b>	Arango, Francisco (FARANGO@iadb.org)
	<b>Project Title</b>	Market Entry of Electric Buses for Mass Transit in Colombia
	<b>Project Number</b>	CO-T1278
	<b>Safeguard Screening Assessor(s)</b>	Arango, Francisco (FARANGO@iadb.org)
	<b>Assessment Date</b>	2011-10-14
	<b>Additional Comments</b>	

<b>PROJECT CLASSIFICATION SUMMARY</b>	<b>Project Category:</b> C	<b>Override Rating:</b>	<b>Override Justification:</b>
			<b>Comments:</b>
	<b>Conditions/ Recommendations</b>	<ul style="list-style-type: none"> <li>No environmental assessment studies or consultations are required for Category "C" operations.</li> <li>Some Category "C" operations may require specific safeguard or monitoring requirements (Policy Directive B.3). Where relevant, these operations will establish safeguard, or monitoring requirements to address environmental and other risks (social, disaster, cultural, health and safety etc.).</li> <li>The Project Team must send the PP (or equivalent) containing</li> </ul>	

		the Environmental and Social Strategy (the requirements for an ESS are described in the Environment Policy Guideline: Directive B.3) as well as the Safeguard Policy Filter and Safeguard Screening Form Reports.
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SUMMARY OF IMPACTS/RISKS AND POTENTIAL SOLUTIONS	Identified Impacts/Risks	Potential Solutions

ASSESSOR DETAILS	Name of person who completed screening:	Arango, Francisco (FARANGO@iadb.org)
	Title:	
	Date:	2011-10-14



Ministerio de Transporte  
República de Colombia  
NIT. 899.999.055-4

#36424989

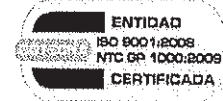
Prosperidad  
para todos

Para contestar cite:

Radicado MT No.: 20111010464991



19-09-2011



Bogotá, D.C 19-09-2011

Señor

**JAVIER LEÓN**

Representante en Colombia

Banco Interamericano de Desarrollo – BID-

Carrera 7 No. 71-21 Torre B Piso 19

Bogotá, D.C.

Asunto: Solicitud de recursos no reembolsables bajo la modalidad KCP Advisory Services

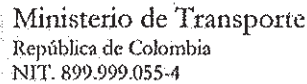
Estimado Señor León,

Desde el año 2002, el Gobierno de Colombia, a través del Ministerio de Transporte, se encuentra implementando la Política Nacional de Transporte Urbano (PNTU) para mejorar los sistemas de Transporte Público de pasajeros en el territorio Nacional. Gracias a esta política, se han logrado implementar Sistemas de Transporte Masivo en las ciudades principales de Colombia, posicionando al país como un referente regional en el manejo de sistemas de Transporte urbanos.

El apoyo del Banco Interamericano de Desarrollo (BID) ha sido fundamental en el desarrollo y ejecución de varias de las estrategias y acciones derivadas de la PNTU, como la estructuración del proyecto de Sistemas Estratégicos de Transporte Público, la implementación del Sistema de Transporte Masivo en Cali y la preparación del Plan de Inversiones de Colombia para participar del *Clean Technology Fund* (CTF).

En este contexto, muy amablemente quisiera solicitar la aprobación y ejecución por parte del BID de recursos no reembolsables bajo la modalidad KCP-Advisory Services (fondos SECCI), los cuales promueven el desarrollo y uso de fuentes de energía renovable, así como tecnologías eficientes para su uso e impacto en el cambio climático. Estos recursos de KCP apalancarán la introducción de tecnologías limpias para los Servicios de Transporte Público y el desarrollo de corredores de Transporte de Cero Emisiones.

Objetivos específicos: (i) Evaluar la factibilidad financiera de incorporar buses con tecnologías limpias (e.g. híbridos, eléctricos) en el Sistema Integrado de Transporte Público en Bogotá; (ii) Desarrollar las especificaciones técnicas y realizar los pre-diseños vehiculares para el corredor de transporte masivo de la Avenida Séptima; (iii) Diseñar un mecanismo de renovación (retrofit) para la flota de buses articulados que se retirará del sistema Transmilenio.



# Prosperidad para todos

Radicado MT No.: 20111010464991



19-09-2011



El monto del KCP propuesto es de US\$350.000 y su periodo de ejecución sería de 12 meses. La entidad beneficiaria de estos recursos sería el Ministerio de Transporte, siendo el BID el organismo ejecutor.

Agradezco su amable atención,

**FELIPE TARGA RODRIGUEZ**  
Viceministro de Transporte

## Anexos:

Cópias:

Elaboró: Luz M. Ramos

Revisó: Felipe Targa

Fecha de elaboración: Septiembre 19 de 2011.

Número de radicado que responde: 20111010464991

Tipo de respuesta: Total ( ) Parcial ( )