



**TECHNOLOGICAL TRANSFORMATION  
PROGRAM FOR BOGOTA'S INTEGRATED PUBLIC  
TRANSPORT SYSTEM**

**COLOMBIA**

**IDB PUBLIC SECTOR**

**CTF PROPOSAL**

# COLOMBIA

## TECHNOLOGICAL TRANSFORMATION PROGRAM FOR BOGOTA'S INTEGRATED PUBLIC TRANSPORT SYSTEM

### PROPOSAL FOR SUBMISSION TO THE CTF TRUST-FUND COMMITTEE

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### ABBREVIATIONS

ARF	Acuerdos y Requisitos Fiduciarios [Fiduciary Requirements and Agreements]
Bancóldex	Banco Colombiano de Desarrollo Empresarial y Comercio Exterior [Colombian Bank for Business Development and Foreign Trade]
CCLIP	Conditional Credit Line for Investment Projects
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon Dioxide
CONPES	Consejo Nacional de Política Económica y Social [National Economic and Social Policy Council]
CTF	Clean Technology Fund
FTD	Fixed Term Deposit
EEO	Enlace Electrónico Opcional [Optional Electronic Link]
EER	Enlace Electrónico Requerido [Required Electronic Link]
Findeter	Financiera de Desarrollo Territorial [Financial Institution for Territorial Development]
GDP	Gross Domestic Product
GoC	Government of Colombia
GHG	Greenhouse Gases
IADB/Bank	Inter-American Development Bank
IFL	Institución Financiera Local [Local Financial Institution]
IRR	Internal Rate of Return
NO <sub>x</sub>	Nitrogen Oxide
PM	Particulate Matter
PCR	Project Completion Report
NPV	Net Present Value
NUTP	National Urban Transportation Program
PCM	Program Credit Manual
POD	Proposal for the Development of the Operation
SITP	Sistema Integrado de Transporte Público [Integrated Public Transportation System]
SO <sub>x</sub>	Sulfur Oxide

**PROJECT SUMMARY**

**TECHNOLOGICAL TRANSFORMATION PROGRAM FOR BOGOTA'S INTEGRATED PUBLIC  
TRANSPORT SYSTEM  
CO-L1096**

<b>Financial Terms and Conditions</b>					
<b>Borrower:</b> Banco de Comercio Exterior de Colombia S.A. (Bancóldex)		<b>Amortization period:</b>		40 years	
<b>Guarantor:</b> República de Colombia		<b>Disbursement period:</b>		48 months	
<b>Executing Agency:</b> Bancóldex		<b>Grace period:</b>		10 years	
<b>Source</b>	<b>Total (US\$)</b>	<b>Interest rate:</b>		0.25% fixed	
IADB (CTF)*	40,000,000	<b>Management Fee:</b>		0.45% one-time fee	
Project Total	40,000,000	<b>Currency:</b>		US Dollars	
<b>General Vision of the Program</b>					
<p><b>Program objective:</b> The main objective of the program is to improve public transportation in Bogotá. The specific goals are to reduce the operating costs of transportation as well as local pollution and greenhouse gas (GHG) emissions associated with Bogotá's public transportation system.</p>					
<p><b>Conditions prior to the first disbursement:</b> The first disbursement of funds for this program is conditioned on the completion of the following requirements to the satisfaction of the IADB: i) formal appointment of the Coordinator of the Program by Bancóldex (¶3.2); ii) approval of the Program Credit Manual (PCM) by Bancóldex (¶3.4); iii) approval of the investment plan for the first 180 days of the program by Bancóldex (¶3.6); and iv) the coming into force of an agreement or another suitable mechanism between Bancóldex and Transmilenio S.A. so that twice a year the latter will provide the required information to evaluate environmental compliance by the program (¶2.5).</p>					
<p><b>Exceptions to IDB Operational Policies:</b> A partial exception is required regarding the IDB Operational Policy "Guarantees Required from the Borrower" (OP-303), since the Republic of Colombia will only guarantee those financial obligations derived from the loan contract (¶3.7).</p>					
<b>The project is consistent with the Country Strategy:</b>				YES [X] NO [ ]	
<b>The project classifies as:</b>	SEQ <input type="checkbox"/>	PTI <input type="checkbox"/>	Sector <input type="checkbox"/>	Geographic <input type="checkbox"/>	% of beneficiaries <input type="checkbox"/>
<p>* Document GN-257: "Proposal to Establish a Clean Technology Fund (CTF) at the Inter-American Development Bank."</p>					

## I. DESCRIPTION AND RESULTS MONITORING

### A. Background, Problem Addressed, Justification

- 1.1 **Socioeconomic context.** With a population of 7.6 million, Bogotá comprises about 16% of the country's population. Its Gross Domestic Product (GDP) represents 24.5% of the country's total<sup>1</sup>, with an economic growth rate of 6% in 2011. Regarding the labor market, close to 54% of the population is economically active, and this work force has the highest levels of education and training in the country<sup>2</sup>. The business community of the city, together with that of the department of Cundinamarca, is the largest in Colombia, comprising 25% of all the companies in the country. As a result, the city faces the daunting task of providing efficient transportation services that enable the development of its economic potential, increase competitiveness, and improve the quality of life of its inhabitants.
- 1.2 **Motorization and urban transportation.** In the city of Bogotá there are 8.8 million motorized trips a day,<sup>3</sup> with public transportation being the predominant mode<sup>4</sup>. Sixty seven percent of households in Bogotá do not own any type of motor vehicle, and 90 percent of the people who use mass transit do not own a car or have access to one. Despite this, high levels of motorization have increased the number of private automobiles in the city<sup>5</sup>, which in turn have increased the levels of traffic congestion. The main challenge facing the city faces is to keeping public transportation as the predominant mode of transport with the purpose of providing efficient and sustainable mobility.
- 1.3 Over the last 15 years, Bogotá has invested heavily in the development of a Bus Rapid Transit system known as Transmilenio. The city currently features a network of 102 kilometers of exclusive busways for high capacity buses in the busiest road corridors. Thirty one percent of public transport trips take place on the Transmilenio. This system features a relatively high level of service due to its organization, regulation, and infrastructure. The remaining 69% of public transit trips occur on the so called Collective Public Transport (TPC for its Spanish acronym), which encompasses the rest of Bogotá's buses, minibuses, and microbuses.
- 1.4 **The Problematic of the TPC.** Even though the TPC accounts for the majority of public transit trips, historically it has faced problems that are common to many cities in Latin America. Firstly, in the past this system has been known for having an oversupply problem, where the number of public transportation vehicles exceeded the existing demand by passengers. Studies have shown that in 2005

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<sup>1</sup> Departamento Administrativo Nacional de Estadística (DANE), Cuentas Nacionales, 2011.

<sup>2</sup> Cámara de Comercio de Bogotá, 2010.

<sup>3</sup> Encuesta Distrital de Movilidad, 2011.

<sup>4</sup> In Bogotá the number of public transport trips reaches 5,2 million, that is, 58 percent of all motorized trips.

<sup>5</sup> Between 2002 and 2010, the number of private automobiles in Bogotá increased from 350,000 to 757,000.

there was an excess of 7,500 buses in Bogotá<sup>6</sup>. Oversupply has been the main reason for both additional traffic in the streets and low speeds. Secondly, the buses of the TPC have been traditionally obsolete both in terms of age and vehicle design. In 2010, the average age of the bus fleet was 11.5 years, and 37 percent of all buses were more than 15 years old<sup>7</sup>. This aging public transportation fleet has a negative impact on the environment due to the high levels of pollution emissions. Thirdly, the TPC lacks a system of bus stops with the appropriate technical conditions for passenger waiting and boarding. This situation, added to the fact that many different transit services compete for passengers in the streets, has generated a high accident rate involving both other vehicles and passengers themselves.

- 1.5 One of the structural reasons for the operational inefficiency of the TPC has been its business model. Small bus owners --whose compensation arrangements are not linked to efficiency or quality of service-- have traditionally been in charge of the operation. On the contrary, their compensation has depended exclusively on the number of passengers transported by vehicle. Labor relations between owners and drivers tend to be based on informal agreements, which reinforce the competition for passengers on the streets. The inability of small owners to reinvest in the maintenance and renovation of their vehicles has contributed to the aging of the public transportation fleet.
- 1.6 **Environmental Impact.** The inefficiency of the TPC and the age of the fleet have contributed to worsen the environmental conditions of the city. Bogotá is one of the cities in Latin America with the highest levels of air pollution<sup>8</sup>, where close to half of local contaminants (nitrogen oxide or NO<sub>x</sub>, Sulfur oxide or SO<sub>x</sub>, carbon monoxides or CO and Particulate Matter or PM) originate in mobile sources of air pollution<sup>9</sup>. These emissions are directly related to the number of vehicles, their technology, and the level of traffic congestion.<sup>10</sup> The cost of air pollution is related to mortality rates (i.e., cardiovascular disease and lung cancer) and to respiratory morbidity<sup>11</sup>. Regarding greenhouse gas (GHG), emissions Bogotá's public transit contributes close to 0.6 million tons of carbon dioxide (CO<sub>2</sub>) annually. Considering both the oversupply of the TCP and the aging fleet, public transit has been identified as one of the sectors with the highest potential for improving environmental conditions in the city and climate change mitigation.
- 1.7 **Country Strategy.** The Government of Colombia (GoC) has acknowledged the relevance of urban transit in strengthening the cities' competitiveness, improving environmental conditions, and mitigating the impacts of climate change. Through the National Urban Transportation Program (NUTP), the National Government designed a policy aimed at improving urban public transit systems in Colombia's

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<sup>6</sup> Ardila. La olla de presión del transporte público; Revista de Ingeniería Universidad de Los Andes, 2005.

<sup>7</sup> Cámara de Comercio de Bogotá, 2010.

<sup>8</sup> Universidad de los Andes, 2011.

<sup>9</sup> Ministerio de Ambiente, Vivienda y Desarrollo Territorial, 2011.

<sup>10</sup> Average annual speed, January – December (23.67 km/h). Source: Secretaría Distrital de Movilidad, 2010.

<sup>11</sup> In 2007 some 4,000 deaths could be attributed to causes related to air pollution.

- main cities<sup>12</sup>. The NUTP supports the development of transportation systems in large and medium-sized cities by participating in infrastructure financing and supporting project implementation.
- 1.8 In 2010 Colombia presented its investment plan to the Clean Technology Fund (CTF) to obtain support for transformational projects that will lower carbon emissions<sup>13</sup>. In this plan, US\$40 million were assigned to the Integrated Public Transportation System (SITP) of Bogotá, to be implemented by the IADB. This project was selected for its potential to reduce GHG emissions and for the transformational effect that it can have in the transportation sector, and eventually in other countries. The CTF resources are highly concessional and will be used to finance additionality on an existing project.
- 1.9 **The SITP.** In Bogotá the SITP is being implemented with the objective to improve the quality of public transit, which in turn will improve the quality of the TPC through the elimination of the oversupply of services, the modernization of the bus fleet, the implementation of a hierarchical network of routes, the formalization of operators, and the implementation of an integrated fare for all services under one payment system. The SITP was designed in 2009 and is being implemented gradually, in order to ensure a smooth transition to the new operating scheme. Once it is fully implemented, the city will have a cleaner and more efficient system under an organized operation scheme with routes, bus stops, and terminals. The integrated fare system will reduce the cost of bus transfers, benefiting those passengers who live in remote zones and who, in the case of Bogotá, tend to be the lower income segments of population.
- 1.10 The SITP consolidates the public transit service of Bogotá in 13 zones. The operation of the transit service for each zone has been granted in concession to transportation companies. These companies are principally comprised by the original carriers of the TPC, who are migrating from an informal organization to service business scheme. The process of awarding zones to transportation companies (concessionaires) ended in 2010; since then these companies have been preparing to make the required investments.
- 1.11 The quality of the service in zones under concession will be regulated through concession contracts. These contracts indicate the obligations of the concessionaires both during the implementation period and the operation of the SITP<sup>14</sup>. These obligations include those related to the purchase of new vehicles and to the levels of service. Unlike the TPC, in the SITP the level of service will be monitored on the basis of indicators that are defined within the concession

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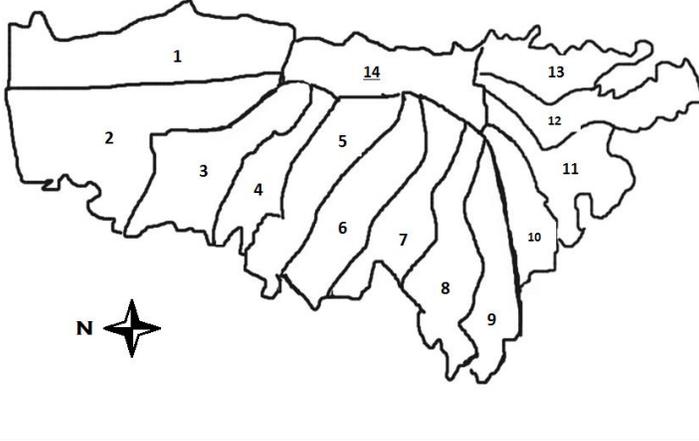
<sup>12</sup> The PNTU was designed as part of the National Economic and Social Policy Council (CONPES by its Spanish acronym) Document No. 3167 of 2003, which was followed up by CONPES 3260 of 2003 and CONPES 3368 of 2005. The objectives of this policy framework are: i) improving the efficiency and safety of urban transport public services; ii) providing access to reliable public transport to low-income population; iii) fostering private sector participation in the provision of transport services; iv) abating air pollution and GHG emissions; v) promoting integral processes of urban sustainable development; and vi) respond to the challenges posed by climate change.

<sup>13</sup> The plan was recently revised and presented to the CTF on May 3, 2013. During that review it was decided that the proposed program would be a priority.

<sup>14</sup> The duration of a contract of operation will be 24 years.

contracts. This will guarantee that the incentives of the concessionaire are aligned with the quality of service perceived by the users.

**Table 1. Integrated Public Transportation System of Bogotá**

			<p><b>Zones of Operation</b></p> <p>1. Usaquén            8. Kennedy                  2. Suba                9. Bosa                  Oriental            10. Perdomo                  3. Suba Centro    11. Ciudad                  4. Calle 80        Bolívar                  5. Engativá        12. Usme                  6. Fontibón        13. San                  7. Tintal             Cristóbal                                               14. Zona Neutra</p>
Type of Vehicle	Capacity (passengers)	Number of Vehicles	<b>Basic Characteristics of the SITP:</b> i) consolidation of the services in 13 operation zones; ii) service regulated by concession contracts with operating companies; iii) fleet supply optimization: reduction from 16,000 to 9,000 vehicles; iv) integrated fare through a single payment method; v) organized public transport operation scheme, based on 6,400 stops and monitored from nine control centers.
“Bus padrón”	80	2,000	
“Bus mediano”	50	4,400	
“Bus pequeño”	40	1,500	
“Microbús”	19	2,000	
Total		9,900	

1.12 The SITP will rationalize and renew the supply of buses in the TCP, so that obsolete vehicles can be replaced. The number of buses will be cut down from 16,000 to 9,900, an adequate supply which will have the capacity to meet the demand for public transportation in Bogotá. Similarly, the life span of diesel buses will be limited to 12 years, hence removing all those vehicles that exceed the established age. One of the contractual obligations pertaining to the concessionaire companies of the SITP is that they must be able to demonstrate the adequate removal and final disposal of those vehicles of the SITP that are out of service.

1.13 Additional obligations by concessionaires include staff training, vehicle refurbishing, fleet set up and maintenance, and complying with current environmental legislation. The responsible entity for monitoring the compliance of all contracts pertaining the SITP is Transmilenio S.A., which has been in charge of supervising the fulfillment of contractual obligations with the Transmilenio system since 1999. The implementation of the SITP began in 2010 with the allocation of operation zones and is evolving gradually. Since 2012 Transmilenio S.A. has continued to progressively implement various elements encompassed by the SITP.

1.14 **Types of Buses in the SITP.** The SITP has been designed to fulfill the demand by passengers following a system of routes according to their importance. The busiest corridors are served by the trunk routes of the Transmilenio system.

Services belonging to routes other than the main corridors are referred to as “zonal services” and will be served by buses with a maximum capacity of 80 passengers<sup>15</sup>. Transmilenio S.A. will regulate the incorporation of buses according to a timetable of vehicle acquisition as agreed upon by each one of the concessionaires.

- 1.15 **Bus Technology.** Currently all buses within the TPC are powered by diesel fuel. Concessionaires in the SITP can decide on the type of technology to operate when purchasing each new bus, as long as it complies with technical specifications regarding weight, capacity, and power required by Transmilenio S.A. Even though diesel-powered buses are still the less costly option<sup>16</sup>, the market currently offers technology alternatives that are cleaner than diesel, readily available, and meet the technical requirements of the SITP. Such is the case of hybrid and electric buses that are known as clean technology buses because of their low emission levels.<sup>17</sup>
- 1.16 Hybrid buses combine conventional internal combustion engines with a system of electrical propulsion. With this electric source of power, savings exceed those of conventional vehicles. Hybrid buses do not require additional investments in infrastructure. Also, hybrid systems consume less energy and therefore reduce emissions of CO<sub>2</sub>, NO<sub>x</sub>, and PM.
- 1.17 Electric buses work with electric engines that function according to controllers that regulate their power. These buses derive their power from battery packs that need to be recharged after a few hours, using an electric source. Electric buses generate zero emissions, while the emissions generated by the electric system are close to zero. A fleet of electric buses requires either the installation of charge stations in bus terminals, a combination of fast charging with long charge sessions overnight, or charging several times a day at bus stops.
- 1.18 Hybrid and electric buses are being used successfully in several cities throughout the world. This is particularly the case of hybrid technologies that have been on the market for several years. Hybrid fleets exist in various cities in developed and developing countries (i.e. México D.F., New York, London). The performance of this technology has met expectations, yielding savings close to 30 percent in fuel consumption. On the other hand, battery-based electric buses are still early stages of commercialization. Despite this, cities like Shenzhen and Shanghai in China are already using them on a massive scale.
- 1.19 **Hybrid and Electric Buses Tests.** In order to demonstrate the reliability and efficiency of clean technologies, the IADB financed tests involving hybrid and electric buses<sup>18</sup> in Bogotá and other cities of Latin America. The results show that

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<sup>15</sup> Bus capacity –19, 40, 50 and 80 passengers—will vary in the zonal services according to the type of route.

<sup>16</sup> Approximate cost estimates for diesel, hybrid, and electric buses with capacity for 80 passengers are as follows: US\$180,000; US\$290,000; US\$450,000 respectively.

<sup>17</sup> Emission reductions in a hybrid vehicle are quite significant: CO<sub>2</sub> 26 percent; NO<sub>x</sub> 62 percent; MP<sub>1.5</sub> 72 percent; THC 73 percent; and CO 80 percent. For electric buses reductions amount to almost 100 percent.

<sup>18</sup> [Technical Cooperation RG-T1798](#).

their performance surpasses that of conventional diesel-powered vehicles in terms of emissions and energy efficiency.

- 1.20 Emissions and energy consumption were measured in 17 buses during 30 hours of operation under normal driving conditions along routes previously agreed between local authorities and transportation operators in participating cities. Hybrid buses with parallel configuration registered 26 percent less CO<sub>2</sub> emissions than those of traditional, diesel-powered vehicles under comparable conditions of weight, routes, and traffic. Similarly, in comparison to diesel-powered technologies, average reductions of local pollutants for hybrid technologies were 62 percent for NO<sub>x</sub>, 72 percent for PM, 73 percent for unburned hydrocarbons and 80 percent for CO. Battery powered electric buses were not measured given the technology has zero emission of local pollutants.
- 1.21 Energy consumption for diesel, hybrid, and electric buses was also measured. The results varied between cities but in all cases energy efficiency of hybrid and electric buses was higher than the traditional diesel-powered buses. Particularly, the average fuel consumption of the hybrid technologies was 31 percent lower than that of diesel-powered bus. Results for electric technologies varied across cities by vehicle type. Cost equivalent energy consumption was 77% lower in the electric buses were tested.
- 1.22 **Finance for the SITP.** The SITP includes investments in transportation infrastructure, vehicle modernization, and complementary systems. Investments in infrastructure mainly include the construction of bus stops, transfer stations, and bus maintenance yards. These investments will be made by the public sector or by public-private partnerships. Investments in vehicles and complementary systems will be fully financed by concessionaire firms based upon the requirements of the SITP concession contracts. Investment in vehicles will amount to approximately US\$840 million over the concession period of 24 years<sup>19</sup>. In order to meet these investment requirements, concessionaire firms can either use their own capital and or obtain financing through Local Financial Institutions (IFLs by its Spanish acronym).
- 1.23 **Proposed Program.** This program will finance the acquisition of a pilot fleet of clean technology vehicles for the SITP. Through this program the IADB will support the implementation of the SITP and promote the adoption of clean technologies in public transport. The program will finance new buses, which will be incorporated into the SITP by the concessionaires to operate in their respective service zones. The demand of vehicles will derive from the SITP's implementation timetable, according to which over 4,000 buses will be incorporated into the system between 2013 and 2017.
- 1.24 **IADB's Involvement.** In its Country Strategy with the Republic of Colombia (GN-2661-4), the IADB identified both low investment rates and management deficiencies in the urban transportation sector as the main obstacles to improve the public transit service. In accordance with this strategy, by means of this

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<sup>19</sup> Net Present Value (NPV) in 2012 US dollars.

program the IADB supports the strengthening and modernization of public transportation companies with the goal of improving the quality of service. The program is aligned with the objectives of the Ninth General Capital Increase (GCI-9) and contributes to institutional priorities regarding climate change and environmental sustainability. Several operational divisions of the Bank have contributed to the preparation of this program: Transportation (INE/TSP), Capital Markets and Financial Institutions (IFD/CMF), and Climate Change and Sustainability (INE/CCS).

- 1.25 In Bogotá, the Bank has supported the structuring of the SITP with an institutional Loan Operation<sup>20</sup> and two Technical Cooperations.<sup>21</sup> The financed studies contain a detailed analysis of existing opportunities for environmental improvement in public transportation. In this regard, one of the main recommendations is to take advantage of the opportunity to modernize the vehicles of the SITP moving towards clean technologies such as hybrid and electric buses due to their environmental benefits.
- 1.26 **Use of Concessional Funds.** Initial investment costs in clean technology vehicles are still higher vis-à-vis diesel-powered vehicles. Even though operational savings are significant, a market for new technologies has not yet emerged in Bogotá. Therefore, CTF funds can become an additional economic incentive to facilitate the adoption of clean technologies by the SITP. In order for the transformation of the bus fleet in Bogotá to take place, operators will need to be adequately funded. With low interest rates and longer repayment and grace periods, credit line with CTF funding could offer additional incentives, so that concessionaires will not remain indifferent when it comes to choosing between a clean technology bus and a diesel-powered bus.

## **B. Objective, Components, and Costs**

- 1.27 **Objective.** The general objective of this program is to improve public transportation in Bogotá. Specific objectives include cost reductions in operational costs, abatement of local pollution, and emission reduction of GHG associated to public transportation in Bogotá.
- 1.28 **Single Component: Finance.** The objective of this component is to finance a series of sub-loans aimed at the acquisition of clean technology buses for the SITP. This single component amounts to US\$40 million, which will be executed by Bancóldex. Bancóldex will be the source of financing for IFLs, which in turn will directly finance SITP concessionaires firms through credit lines. Under this program, Bancóldex and the IFLs will co-finance each one of the vehicles in equal parts. This means that the US\$40 million of this program will leverage an equal amount, for a total of US\$80 million. Funds will be offered with attractive financial conditions and will contribute to compensate the price difference regarding the starting cost of clean technologies.

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<sup>20</sup> Loan Operation [CO-L1076](#).

<sup>21</sup> Technical Cooperations [CO-T1146](#) y [CO-T1202](#).

- 1.29 **Other Related Activities.** This operation is linked to technical assistance activities<sup>22</sup> aimed at advancing knowledge of the operational and commercial aspects of clean technologies for concessionaire firms of the SITP. The IADB is providing support to local authorities to develop a friendly business climate for providers of clean technologies and concessionaire firms working with the SITP. The city's Environment Secretariat is collaborating with the C40 Cities Climate Leadership Group to set up working groups through which operators will become better acquainted with the different alternatives offered by the market regarding clean technology public transportation vehicles, while manufacturers can promote their products using innovative business models. These working groups encompass more than 15 providers of clean technology vehicles and all of the concessionaire firms working with the SITP, and will be in place during the first semester of 2013.
- 1.30 **Expected Results.** This program will finance approximately 282 medium-sized passenger buses<sup>23</sup> (up to 80 passengers), either hybrid or electric. The financing of clean technology vehicles will directly support the SITP objectives of reducing operating costs in public transportation and improving the environment, thus benefitting the population as a whole. As a result, financing for clean technology buses will increase the benefits of the implementation of the SITP by generating further reductions in operating costs and associated emissions.
- 1.31 Beyond financing these units, the program will contribute to overcome the initial barriers for the adoption of clean technology in public transit and will generate confidence both in the market of suppliers of this technology and in concessionaire firms. The impact of this program is not limited to the buses that will be directly financed (3% of the total buses in Bogotá) but will also have transformational effects in all public transport. The SITP offers a unique opportunity to transform a large percentage of the public transit fleet to clean technologies. It is expected that the confidence that the program will generate in bus suppliers and concessionaires will encourage further development of the clean technology market.
- 1.32 Moreover, impacts of this intervention could be replicated in other cities in Colombia and the region. In the same way that the Transmilenio (Bus Rapid Transit) has been replicated in over 30 cities around the world, the SITP model has a high potential for being adopted in other cities with the goal of offering passengers an integrated multimodal system of travel that is both well organized and environmentally sustainable. Some cities in Latin America such as Santiago de Chile and São Paulo have already made significant progress in this respect. In Colombia, at least two cities have already demonstrated an interest in integrating their different public transit services.

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<sup>22</sup> Technical Cooperation [CO-T1278](#).

<sup>23</sup> The total of buses financed will vary according to demand. A total of 282 buses was estimated under the assumption that 50% of the resources will be invested in hybrid buses and 50% in electric buses. Other variables, like the technical specifications, final market price, and financing scheme of each unit (co-financing with the IFL and/or suppliers) can also affect the number of units financed. This will be adjusted to respond to market demand.

### C. Key Results Indicators

- 1.33 The SITP will bring benefits to the system users and to the city mainly associated with the reduction of the oversupply of vehicles and the modernization of the bus fleet. These benefits will be further increased by the incorporation of clean technology vehicles. The results indicators of the program include: i) reduction in operating costs (US\$ per year) ii) reduction in local pollution (tons of PM per year); iii) reduction in GHG emissions (tons of CO<sub>2</sub> per year); and iv) number of people with access to public transportation with low carbon emissions.
- 1.34 The Results Matrix includes baseline values, measuring units, and corresponding goals. Indicators have been proposed at two levels: i) impact indicators to assess the results of the full implementation of the SITP and the loan operation at the city level; and ii) results indicators to assess the specific results emerging from the implementation of the pilot fleet financed through the loan operation.

## II. FINANCE STRUCTURE AND MAIN RISKS

### A. Finance Instrument

- 2.1 The program will be financed with US\$40 million from the CTF. Resources will be managed by Bancóldex, which acts as a second-tier bank for the IFLs in the Colombian market. Resources from the program will allow Bancóldex to provide financing with adequate terms and conditions for eligible IFLs. In turn, the latter will provide financing to concessionaire firms so that they can purchase clean technology buses.
- 2.2 Finance for clean technology buses through Bancóldex will be co-financed *pari-passu* with resources from IFLs. Sub-loans from IFLs can also be co-financed with funding from clean technology bus companies and also by bus operators. Specific conditions for the program will be defined in the Program Credit Manual (PCM). Bancóldex will define unilaterally the conditions and characteristics of financing and will release information to the IFLs through an official document.
- 2.3 Within this program, finance conditions for IFLs are as follows: i) funds will be in Colombian Pesos; ii) interest rate will be variable (interest rate for the program plus Bancóldex interest spread); iii) will be equal or less than the Fixed Term Deposit rate (DTF); iv) it will cover up to 50% of the financing for eligible buses; v) Bancóldex will bear the risks of the IFLs; and vi) IFLs will bear the risks of concessionaire firms that obtain sub-loans to purchase clean technology buses.
- 2.4 Bancóldex will provide financing under the following criteria:
- i) **Eligibility.** Eligible IFLs will be those who comply with the requirements mentioned in paragraph ¶3.3 of this document. Eligible investment projects will be those aimed at purchasing clean technology buses for up to 80 passengers by concessionaire firms that operate Bogotá's SITP. Eligible technologies under the program are hybrid and electric buses.
  - ii) **Financing.** Depending on existing demand, the program will finance IFLs for a period of up to 12 years, with a grace period of up to 36 months and a discount rate that is equal or less than the DTF rate

- iii) **Characteristics of loans granted to concessionaire firms.** These will be: a) denominated in Colombian Pesos; b) interest rates are to be freely negotiated between final beneficiaries and the IFLs, taking into account the risk profile of each borrower, the risks entailed by sub-loans, and the discount rate offered by Bancóldex; c) repayment period for up to 12 years<sup>24</sup>, with a grace period of 36 months; and d) for a maximum amount to be defined in the RCP, with the possibility of obtaining additional co-financing by IFLs, the suppliers of clean technology buses and/or the final beneficiaries themselves.

## **B. Environmental and Social Safeguard Risks**

- 2.5 The current program provides Bancóldex with funding for second-tier loan operations. Therefore, the impacts and environmental and social risks will occur at the sub-loan level. In accordance with directive B.13 of the Environment and Safeguards Compliance Policy (OP-703), this operation does not require classification. Furthermore, in light of the specificity of the loan operation, most of its socio-environmental impacts are expected to be positive, while the adverse effects will be small and manageable. The substitution of old buses for new, clean technology buses will translate into a reduction of energy consumption from fossil fuels, and therefore will have a positive impact on climate change. In fact, energy reduction will result in the abatement of GHG emissions and local pollutants. However, this type of project can have adverse effects on the environment if the old buses are not adequately retired from circulation, and if the disposal of some of the parts of the new buses (i.e., the batteries of hybrid and electric buses) is not properly done. To mitigate this risk, a Protocol for Residue Management will be an integral part of the PCM of the program. This will enable the identification of potential environmental and social risks associated with the substitution of bus technology. Also, it will ensure the implementation of the protocol as well as the mitigation measures deemed necessary by IFLs and sub-loan beneficiaries. Such measures are usually included in the contracts between Transmilenio S.A. and its concessionaires, which in turn are the potential sub-borrowers. Verification of mitigation measures will be completed in accordance with Bancóldex norms regarding environmental and social risks, and also according to the Protocol for Residue Management agreed with the IADB. **Prior to the first disbursement, an agreement or an alternative appropriate mechanism between Bancóldex and Transmilenio S.A. must come into force in order for Transmilenio S.A. to provide, twice a year, the information required to evaluate the compliance of the program's environmental requirements.** Specific requirements that will be included in the PCM are described in the Environmental and Social Management Report.

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<sup>24</sup> Idem 23.

### C. **Fiduciary Risks**

- 2.6 Bancóldex is an institution with solid experience in the execution of IADB resources. A recent assessment concludes that Bancóldex has sufficient capacity to perform the financial management and the administration of the loan. Fiduciary risk in financial management is low. Bancóldex has experience in loan programs with the IADB and has demonstrated its capacity as borrower and executor via the existing programs under the Conditional Credit Line for Investment (CCLIP). In this regard it is currently successfully implementing operation 2193/OC, “Proyecto de Inversión, Reconversión Productiva y Desarrollo Exportador” [Loan for Investment Financing, Restructuring, Business Development]. Also in December 2012 the IADB approved Loan 2886/OC-CO “Programa de Promoción de Servicios Tercerizados” [Program to Promote Outsourced Services], which will be implemented by Bancóldex starting in 2013.
- 2.7 Bancóldex is supervised by several government agencies: the Financial Superintendence of Colombia, the Office of the Comptroller General of the Republic, the National Accounting Office and the regulator of the stock market in the country. Internal control of its operations is under the Internal Auditing Office and the Office of the Fiscal Auditor. Bancóldex has experience in loan programs involving the IADB and has demonstrated its capacity as both borrower and executing agency (See Annex III).
- 2.8 **Procurement.** Financing will be channeled by a financial intermediary (Bancóldex) to private banks and subsequently to private companies. Procurement risks are practically non-existent since this operation does not include direct acquisitions and/or the hiring of consultants. Sub-loans recipients will follow common market practices acceptable to the IADB in the procurement process or the hiring of consultants, following Appendix IV of the Procurement Policies to Provide Goods and Works to the IADB, as well as the Policy for the Selection and Hiring of Consultants financed by the IADB.

### D. **Other Key Aspects**

- 2.9 Two financial risks have been identified for the implementation of this program: i) the risk of not being able to develop the clean technology market and/or to prove that there is such market, which is a prerequisite for Bancóldex to request funds from the IADB, and for the latter to disburse them. In order to mitigate this risk, the IADB has conducted tests with hybrid and electric buses, and it is also supporting the organization of working groups as described in paragraph ¶1.29; and ii) the risk of Bancóldex of not being able to invest loan funds in US dollars so as to obtain a rate of return that allows the granting of concessional terms for credit lines in Colombian pesos. In order to mitigate this risk, Bancóldex will have to actively promote lending activities in US dollars during the implementation of the project.
- 2.10 **Economic Feasibility.** Economic feasibility for this program was assessed within the framework of the SITP through a cost-benefit analysis *ex-ante*. The results show that the program is feasible with a cost-benefit ratio of 1.6 and a Net Present Value (NPV) of US\$419.8 million. This analysis encompasses the full costs of the

- SITP, that is, infrastructure investment, training, technology, and new vehicles, including the clean technology buses that will be financed through the project. It also takes into account all expected benefits such as reductions in operating costs, fuel consumption, PM, and GHG emissions. Sensitivity analysis also shows profitability with different investment and operation costs.
- 2.11 **Financial Feasibility.** Financial feasibility for this program was assessed from the perspective of the concessionaire firms that will purchase clean technology buses. Results show that the investment in hybrid and electric buses will be highly profitable, with an Internal Rate of Return (IRR) of 31.9 percent and 25.1 percent, respectively. This analysis takes into account the investment and operating costs of the buses, including the value of the vehicle, the costs of fuel, and all other operating costs within the framework of the SITP. Similarly, the analysis also took into account the following elements: i) operational savings derived from the new technologies; ii) variations in the calculations regarding compensation within concessionary contracts adjusted to the characteristics of clean technology buses; iii) conditions of concessional financing offered by the program; and iv) the reduction of import duties for hybrid and electric buses from 15 percent to 5 percent.
- 2.12 A profitability analysis of diesel-powered buses was also conducted, taking into account current conditions regarding cost, financing, and operation within the framework of the SITP. Investment in diesel buses will continue to be highly profitable, with an IRR of 32.0 percent. This rate is comparable to that in hybrid buses and higher than in electric buses. During the preparation of this operation, the city of Bogotá indicated that additional economic incentives complementary to the program are being analyzed as well as the pursuit of funding sources with the goal of making clean technology buses even more attractive. The IADB is working with the city throughout this design process in order to implement feasible measures that are financially sustainable in the medium and long term.

### III. IMPLEMENTATION AND MANAGEMENT PLAN

#### A. Execution Mechanism

- 3.1 **Borrower and Executing Agency.** Bancóldex will be the borrower and executing agency of this program. Bancóldex has both the mandate and the financial and operational capabilities required for its implementation. The institution: i) has been established to promote international trade and business development by providing finance; ii) is governed by the “Ley de Bancos e Instituciones Financieras” [Law of Banks and Financial Institutions]; and iii) will function as a second-tier bank using the IFLs to channel its resources and respond to the credit necessities of all economic sectors; iv) it has the fiduciary and operational capacity required for the successful implementation of the program; v) it is solvent and applies best practices in regards to risk management; vi) it has proven to be an effective executing agency of IADB programs; and vii) the government has chosen Bancóldex as one of the institutions that will support its efforts regarding GHG emissions reduction. Bancóldex operates as a second-tier bank that will use a network of previously enabled IFLs.

- 3.2 **Implementation and Administration.** In the context of this program, Bancóldex will be responsible for: i) executing and supervising the adequate use of the loan; ii) providing adequate staff, technologies, and the necessary budget for its implementation in a timely manner; and iii) supplying the IADB with the required documentation to comply with disbursement conditions, as well as other operational documentation required for implementation. **As a condition prior to the first disbursement, Bancóldex will formally designate a program coordinator, who will be the IADB counterpart in regards to its implementation.** The specific functions of the coordinator of the program will be described in the PCM.
- 3.3 **IFL eligibility.** First-tier intermediary IFLs regulated by the Financial Superintendence will be eligible for Bancóldex resources. Their obligations include: i) evaluate the risk of the sub-borrowers and make decisions in regards to financing, as stated in the conditions of the PCM and in Bancóldex's operational standards; and ii) respond for the service and repayment of sub-loans, whether or not sub-borrowers fulfill their obligations.
- 3.4 **Characteristics of the PCM:** i) consistent with the operational policies and norms of Bancóldex and the IADB, and with the financial laws and practices of the country; ii) reflect the main features of the program; iii) stipulate that a breach of provisions will not allow access to financing; iv) **its approval by Bancóldex, prior acceptance by the IADB, will be a condition for the first disbursement;** v) any modifications must be accepted by the IADB; vi) include the Protocol for Residue Management (§2.5).
- 3.5 **Resource Commitment and Repayment.** Funds for this program are expected to be fully committed within the four years following the date in which the loan contract comes into force. Bancóldex will commit to an investment period of up to 12 years.<sup>25</sup>
- 3.6 **Disbursements.** Resources will be disbursed into an account in US dollars in Bancóldex's name under the advance of funds modality. Given the nature and characteristics of this operation, the loan will be disbursed based on the demand for hybrid and electric buses, whose structuring will begin during the first year of implementation. The IADB will make the first disbursement for the value of structured demand. Bancóldex will prove the existence of demand for each disbursement by presenting letters of intent subscribed by those beneficiary firms interested in purchasing clean technology buses. Besides cash flow projections, each disbursement request has to be accompanied by the status of implementation regarding technical and fiduciary commitments. **Bancóldex's approval of the investment plan for the first 180 days will be a prerequisite for the first disbursement.**
- 3.7 **Program Guarantor and Borrowing Authorization.** The Republic of Colombia will serve as a guarantor only regarding those financial obligations derived from the loan. In this sense, a partial exception is required regarding IADB Operational

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<sup>25</sup> Idem **Error! Bookmark not defined.**

Policy “Guarantees Required from the Borrower” (OP-303). This exception has previously been requested for past operations involving Bancóldex and Findeter (Financiera de Desarrollo Territorial). The program will be conducted under a borrowing authorization issued by the Inter-Parliamentary Commission of Public Credit to Bancóldex to borrow from multilateral institutions up to US\$650 M in 2008 (see CONPES 3546).

**B. Monitoring and Evaluation Arrangements**

3.8 **Monitoring.** This program will be monitored on the basis of biannual reports prepared by the executing agency and delivered to the IADB within 60 days after the end of each calendar six-month period. Reports will measure progress regarding program outputs, results, and also regarding the eligibility criteria for the program.

3.9 **Evaluation.** Both the borrower and the IADB will conduct a mid-term evaluation either 24 months after the first disbursement or once 50% of the loan has been executed. This mid-term evaluation will deal with progress achieved regarding objectives and results of the programs according to the Results Framework in order to identify the necessary corrective measures. Monitoring and evaluation arrangements also include an impact evaluation, which will replicate the methodology of an *ex-post* economic evaluation to verify that the development objectives of the program have been achieved on the basis of impact and outcome indicators.

3.10 The IADB will conduct a Project Completion Report (PCR) within three months after the implementation period has concluded. Bancóldex will gather and will make available all relevant information, indicators and documentation related to loan execution, which will be required by the IADB in order to prepare the PCM.

**Financial Audits.** The annual financial statements and eligibility of project expenses for this program will be audited annually by an independent auditing firm to be hired and paid by Bancóldex. The program auditor could be the same firm responsible for auditing Bancóldex’s financial statements and any other IADB programs in execution, as long as it is one of the firms acceptable to the IADB. The auditor will submit a report on the eligibility of project expenses, verify the existence of letters of intent by Bancóldex and conduct visits to physically inspect *in situ* those firms that purchased clean technology buses financed with loan funds. This will be done with the purpose of verifying both the existence and proper functioning of hybrid or electric buses. The project’s audited financial statements will be delivered to the Bank no later than four months after the close of each fiscal year of the executing agency, in accordance with the procedures and terms of reference previously agreed upon with the Bank. The IADB will request the audited financial statement from the borrower and supplementary information related to those statements during the period of execution of the program and until all of its funds have been disbursed. This should be delivered to the IADB according to the timetable set for the audited financial statements of the program.

## **Inter-American Development Bank**

### **Financing Program for the Technological Transformation of Bogota's Integrated Public Transport System**

#### **Program Fit with CTF Investment Criteria**

##### **1. Program Fit with Colombia's Investment Plan.**

**Colombia's CTF Investment Plan:** In 2010, the Clean Technology Fund approved an Investment Plan (IP) for Colombia, which outlines the strategy, sectors, and objectives to be implemented by the Inter-American Development Bank (IDB), the World Bank and the IFC in leveraging additional resources to support climate change mitigation measures. The proposed programs for CTF focus on scaling-up investment in low-carbon technologies that are readily available to Colombia today yet face primarily knowledge, financial and institutional barriers that must be overcome for scaled-up investment. The transport sector was selected for its potential to have a transformational impact, as well as strong demonstration and replication potential in other countries. The IP was recently revised by the Government of Colombia and ratified by the CTF in May 2013.

The IP allocated \$ 40 million for the technological transformation of the Integrated Public Transport System (SITP) in Bogota to be implemented by the IDB. This project was selected for its potential to reduce GHG emissions and for the transformational effect it can have on the transport sector and possibly in other countries. Utilizing CTF resources for integrating low-carbon technologies and measures into the Government's national urban transport policy, and accelerating these investments, presents a major opportunity for Colombia to demonstrate what it takes to transform the transport sector to a lower carbon path.

**Bogotá's SITP:** The SITP has the general objective to improve the quality of public transport. The new system will address Bogotá's public transport issues by eliminating the oversupply of services, modernizing the fleet, implementing a hierarchical network of routes, formalizing business operation and incorporating an integrated fare system. When the SITP is fully implemented, the city will have a cleaner and more efficient transport system under an organized operation system featuring routes, stops and terminals. The integrated fare system will reduce the cost of transfers between buses, benefiting users who live in remote areas. In the case of Bogotá these are often the poor.

The SITP will consolidate Bogotá's transport into 13 operational areas. The transport service operation for each area has been given in concession to transport operating companies. These companies are mainly composed of traditional carriers who are migrating from an informal organization to a formal business scheme. In the SITP, service quality will be regulated by concession contracts. The contracts indicate the obligations of concessionaires during the implementation period and during the operation of the SITP. Obligations include purchase of new vehicles and ensuring their suitability for service.

Moreover, the SITP will rationalize and renew the traditional public transport bus fleet, replacing obsolete vehicles. From a total fleet of 16,000 vehicles in the existing system, a rationalized fleet of 9,900 vehicles will be consolidated. Operational improvements will enable the fleet to meet the entire demand for public transport in Bogotá. Also, the SITP will establish a maximum life span of 12 years for diesel buses in the SITP, automatically replacing of all those units whose age exceeds this limit. The concessionaries of the SITP will have the obligation to report and demonstrate the proper removal and disposal of public transport buses as the age limits are reached.

**Bus technologies in the SITP.** Currently all buses in Bogotá's traditional public transport system use diesel fuel. The SITP concessionaires have the option to choose the type of technology when purchasing the buses that will be incorporated into the SITP, as long as these meet the technical specifications of weight, capacity and power demanded by Transmilenio S.A. Although diesel buses are still the less expensive option in the market, cleaner technology alternatives that comply with technical specifications of the SITP exist with immediate commercial availability. This is the case of hybrid and electric buses, which are known as **clean technologies** for their lower GHG emissions.

**The Financing Program for the Technological Transformation of Bogotá's SITP (IDB Loan):** The program will finance the acquisition of a pilot fleet of clean technology vehicles for the SITP. Through this program, the IDB (with CTF resources) will co-finance the implementation of the SITP and provide additionality by encouraging the adoption of clean technologies in public transport. The proposed program will offer a credit line to channel CTF's concessional resources to SITP concessionaires. The amount of the program is US\$ 40 million, which will be executed by the Banco Colombiano de Desarrollo Empresarial y Comercio Exterior (Bancóldex). Bancóldex is a funding source for Local Financial Institutions (LFI), who in turn will finance SITP concessionaires through specific credit lines.

Under the proposed program, Bancóldex and LFI's will co-finance each clean technology bus on equal shares. This means that the \$ 40 million program will leverage an equivalent amount, totaling US\$80 million. The resources will be offered with attractive financial terms to help offset the initial cost differential of clean technologies. Vehicles financed by the program correspond to new buses that will be incorporated into the SITP by the concessionaires to meet operation requirements in their areas of service. The demand for new vehicles is derived from the SITP implementation, according to which over 4,000 new buses will be incorporated between 2013 and 2017.

**Expected Results.** CTF resources will co-finance the SITP<sup>1</sup>. The SITP is expected to bring a significant improvement in the quality of transport service in Bogotá. CTF resources will finance approximately 282 hybrid or electric buses of medium capacity (up to 80 passengers). CTF financing will support the SITP, bringing a reduction in the operating costs of public transport, environmental improvements and a reduction in GHG emissions. More people will have access to low carbon transport systems. The incorporation of clean technology buses will enhance the

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<sup>1</sup> The SITP includes investments in infrastructure (Bus stops, control centers and terminals), technology (fare collection systems, fleet management systems), vehicles (buses, including CTF financed clean technology buses) and training (drivers, supervisors and other operational staff).

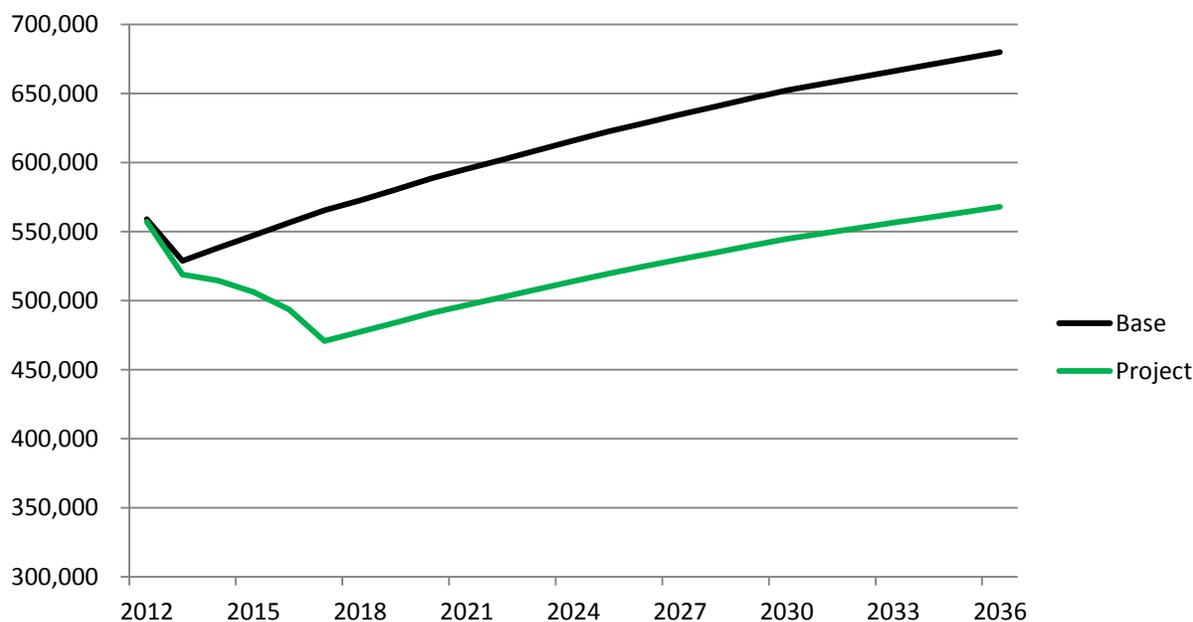
benefits of the SITP by generating an even greater reduction in operating costs, local pollution and GHG emissions.

The total buses financed by the program may vary according to the actual demand. It is estimated that 282 buses will be financed under the assumption that 50% of the funds will be invested in hybrid buses and 50% of resources in electric buses. Other variables such as technical specifications, final market price and the financing scheme of each unit (LFI and / or suppliers co-financing) may also affect the number of units levied by the program. The scope of financing will be adjusted according to market demand.

## 2. Potential for GHG Emissions Savings

**Emissions Reduction Potential of Investment:** The implementation of the CTF co-financed investments will result in direct GHG emissions reductions of **92,308 metric tons of carbon dioxide equivalent per year (tCO<sub>2</sub>e/year) and 2.2 Million tCO<sub>2</sub>e over 24 years<sup>2</sup>**. As shown in Figure 1, the implementation of CTF co-financed investments will have a significant impact reducing Bogota's public transport CO<sub>2</sub> emissions, as a result of: (i) Reduction in the total size of the bus fleet from 16,000 to 9,900 vehicles; (ii) Optimization of the transit routes; (iii) Reduction of the average age of the fleet; (iv) Technological improvement to EURO IV Diesel engines and hybrid and electric buses.

Figure 1: Annual GHG emissions (Ton-CO<sub>2</sub>e) in the Base scenario and Project scenario



<sup>2</sup> The SITP transport concessions were structured for a period of 24 years during which the transport companies are responsible for investing in the vehicle fleet, operating the routes and maintaining the vehicles on a good state of repair.

**Technology Development Status:** The technologies to be financed under the program are commercially available and have a high mitigation potential for replication across other cities in Colombia and the region. Hybrid and electric buses are successfully being used in several cities worldwide. In particular, the hybrid technology has been on the market for a longer number of years and fleets of these buses operating in both developed and developing cities (e.g. Mexico City, London, New York). The technology has performed as expected, delivering close to 30% savings in fuel consumption. On the other hand, electric buses based on batteries are in an earlier stage of commercialization, although cities like Shenzhen and Shanghai are already incorporating electric buses to fleets at a large scale.

Hybrid buses combine a conventional internal combustion engine propulsion system with an electric propulsion system. These types of buses normally use a diesel-electric power-train and are also described as hybrid diesel-electric buses. The electric power-train is intended to achieve better fuel economy than a conventional vehicle. Modern hybrid diesel-electric buses make use of efficiency-improving technologies such as regenerative braking, which converts the vehicle's kinetic energy into electric energy to charge the battery rather than it being dissipated as heat energy whenever the vehicle slows down. Hybrid buses do not require incremental investments in infrastructure. The hybrid system consumes less fuel and correspondingly reduces CO<sub>2</sub>, nitrogen oxides, and particulate matter emissions.

Electric buses are powered by electricity and propelled by electric motors. They can be connected by wires or run on batteries that need to be plugged into an electricity source and recharged over several hours. Battery-based vehicles run on chemical energy stored in rechargeable battery packs and do not have an internal combustion engine. These battery electric vehicles (BEV) or electric buses are dependent on the battery being plugged in at a charging station. Battery electric buses are propelled by motor controllers and electric motors instead of internal combustion engines. A fleet of electric buses requires charging stations in bus terminals, a combination between quick-charging and slow-overnight charging schemes or multiple recharging per day at bus stops, which requires changes to the street infrastructure.

In relation to the potential of emission reductions, IDB's Hybrid-Electric Bus Test Program carried tests in 4 Latin American cities, evidencing GHG emission reductions as well as reductions in local pollutants from hybrid and electric bus technologies compared to conventional Diesel. The results of the Program show that adoption of hybrid buses could reduce CO<sub>2</sub> emissions by up to 35% (26% on average) compared to the reference diesel buses. Average reductions in local emissions of between 60-80% were achieved and a 30% reduction in fuel consumption. Electric buses reduce almost 100% local or GHG emissions and offer up to 77% reduction in energy consumption based on electricity compared with diesel buses.

### **3. Cost-Effectiveness**

The implementation of the SITP considers four main sources of investments:

- a. Infrastructure: Bus stops, control centers and terminals
- b. Technology: Fare collection systems, fleet management systems
- c. Vehicles: Buses, including CTF financed clean technology buses
- d. Training: Drivers, supervisors and other operational staff

The Net Present Value (NPV) of all the SITP investments over the implementation period of 24 years amounts up to USD 1,100 Million, including CTF co-financing. In the Base Line Scenario, which assumes a continuation of the current informal transport system, the total investments in public transport would amount up to US\$782 Million (NPV), mainly dedicated to purchasing diesel vehicles. Thus, the difference in costs between the Project Scenario and the Base Line Scenario is US\$ 318 Million (NPV).

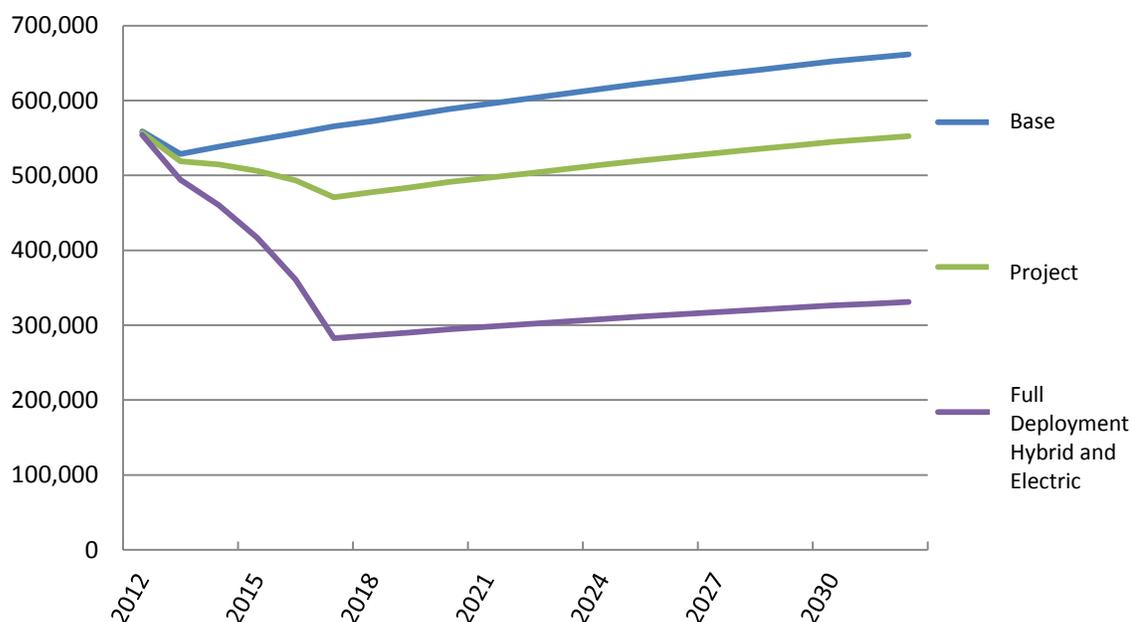
The implementation of the SITP including CTF financing for clean technology buses, is expected to reduce 2,215,410 tCO<sub>2</sub>e in GHG emissions during the period of 24 years. Altogether, the unit abatement cost of the CTF co-financed investments is estimated at **\$143.76 per tCO<sub>2</sub>e** (or an investment of USD 18.06 of CTF resources per tCO<sub>2</sub>e reduced by the program).

#### **4. Demonstration Potential Scale**

**Scope for avoided annual GHG emissions:** The proposed program will contribute to overcome some initial entry-barriers to investment in clean technology buses in Colombia. In particular, it will provide transport companies with an initial confidence into the operation of hybrid and/or electric buses. The program will also increase the capacity of bus manufacturers and energy service providers to provide the vehicles at a large scale, including maintenance support, repair parts, and other product guarantees that operators may consider relevant.

*Replication in the targeted area:* If the technological transformation is successful at the level of the CTF-financed pilot fleet, it is possible for a greater demand of clean technologies to be triggered in Bogotá. This would require the continued commitment of the city, confidence in the reliability and suitability of the technology and a feasible business plan for scaling up the investments. A complete transformation of Bogotá's SITP to clean technologies (50% hybrid/50% electric) would turn into a GHG emission reduction of **280,068 Tons of CO<sub>2</sub>e per year**. The graph below shows the trajectory of direct reduced GHG emissions that would result from the proposed CTF program and from an eventual SITP's bus fleet transformation.

**Figure 2: Annual GHG emissions (Ton CO<sub>2</sub>e) in the Base scenario, the Project scenario and a Full Deployment Scenario**



*Replication in the country:* Bogotá was the city where the Bus Rapid Transit technology was first successfully deployed in a large scale. The results of this experiment in 1999 with Transmilenio are being replicated through the National Urban Transport Program (NUTP) in the large and medium sized Colombian cities<sup>3</sup> with successful results so far. If the implementation of Bogotá's SITP and its full technological transformation was to be successfully implemented, then it is possible that the effects could be replicated in the same cities under the NUTP. Considering that the total population of these 19 cities amounts to 12 Million inhabitants, there is a potential to reduce additional **464,700 Tons of CO<sub>2</sub>e /year**.

*Modal shift:* The current GHG emissions reduction estimation assumes that the users of private vehicles remain using this mode and will not shift to public transport. This was the case in order to keep the estimations on the conservative side given that the project will not have significant reductions in travel times for public transport users. However, it is possible that some private vehicle users use the SITP given that the integrated fare policy will reduce the cost of transfers and thus long trips now may result in greater economic savings. Also, the added comfort of using an integrated system in an organized setting with bus stops and interchange terminals will also make the public transport option more attractive.

The number of car trips per calendar day in Bogotá in 2011 was approximately 1,72 million. This represents about 2 trips per car. Assuming that the implementation of the SITP would cause a

<sup>3</sup> NUTP Cities: *Large cities (Mass Transport Systems):* Medellín, Barranquilla, Cartagena, Pereira, Bucaramanga, Cali, Cucuta; *Medium cities (Strategic Transport Systems)* Santa Marta, Pasto, Armenia, Popayan, Sincelejo, Monteria, Valledupar, Villavicencio, Ibague, Neiva, Buenaventura, Manizales.

modal shift from cars to buses equal to a reduction of 5% in the use of cars, this implies that approximately 43.000 persons would shift from using the car to using the traditional bus system. Considering that the factor emission of a car trip per person is about 4.16 tons of CO<sub>2</sub>e /year and that the factor emission of a bus trip is about 0.27 Tons of CO<sub>2</sub>e /year, therefore the 5% modal shift would represent an additional GHG reduction of approximately **167.000 tons of CO<sub>2</sub>e per year**

*Other Mass Transit Projects in Bogotá:* The successful implementation of the SITP may leverage continued investment in public transport in Bogotá. In particular, additional mass transit investments will be required to increase capacity on high-demand corridors. Additional mass transit projects (either rail or BRT systems) would also increase the CO<sub>2</sub> emissions reductions of the SITP. Even if no modal shift from private vehicles is considered, additional mass transit projects have the potential to reduce CO<sub>2</sub> emissions, as they are generally more efficient on a per-passenger basis than the traditional bus system. Rail systems have a higher potential to reduce CO<sub>2</sub> emissions, as their source of energy is electricity.

Bogota's long term development plan includes two additional corridors of TransMilenio BRT (Av. Boyacá and Av. 68), a Light rail line (7th Avenue) and a heavy rail line. According to the expected demand for each of these projects, considering no on-site emission for the rail lines and assuming that the demand for these projects would come from the traditional bus system, the following table presents the potential CO<sub>2</sub> emissions reduction per year for each project.

**Table 1: Additional mass transport projects in Bogotá and their GHG emissions reductions potential**

Project	Daily demand	Potential for emissions reductions
Light rail line (Avenida Séptima)	350.000 trips per calendar day	47.000 tons of CO <sub>2</sub> per year
Heavy rail line (Line 1)	500.000 trips per calendar day	67.500 tons of CO <sub>2</sub> per year
Two additional corridors of Bus Rapid Transit TransMilenio (Avenida Boyacá and Avenida 68)	500.000 trips per calendar day	34.000 tons of CO <sub>2</sub> per year

In total, the additional investments in mass transport could result approximately into reductions of **150.000 Tons of CO<sub>2</sub>e per year**.

**Transformation potential:** Bogota's SITP has an important transformation potential as a result of the above mentioned sources of additional avoided GHG emissions (Replication in the targeted area, replication in the country, modal shift and additional mass transit). The total transformation potential is, in absolute figures, **1.05 Million Tons CO<sub>2</sub>e per year (25.2 Million Ton over a 24 year period)**. The relative transformational potential is **11.4** and this is the ratio of the transformation potential (1.05 Million tCO<sub>2</sub>e/year) over the expected GHG emission reductions of the project as it currently stands (92000 tCO<sub>2</sub>e/year).

## 5. Development Impact

*Reduction in operational costs.* The proposed program will reduce the operational costs of public transportation. First, the reduction in fuel consumption caused by the rationalization of the vehicle fleet in the traditional bus system is directly related to the reduction in the number of kilometers travelled by the buses. The analysis shows that the SITP implementation will reduce the total number of kilometers travelled by buses by approximately 500,000 kilometers per calendar day in average during the evaluation period. Considering these costs and using a 12% discount rate, the NPV of the fuel consumption savings of the program over a 20 year period amounts up to US\$ 386 million. The savings of the program in other operation costs such as labor and maintenance amounts up to US\$ 222 million over the same period of time. These savings will be greater under a potential scenario of clean technologies full deployment given the larger fuel savings that can be achieved on hybrid or electric technologies.

*Increased affordability.* The SITP will reduce the average cost of a transit fare considering that the integrated fare policy will reduce the cost of transfers. In the base line scenario, transfers are charged at full price<sup>4</sup>. However, when the SITP is fully implemented, transfers will be charged at a discount rate<sup>5</sup>. This means that all those passengers that need to do 1 or more transfers for their trips (38.1% in the SITP) will be benefited. In Bogotá, it is the lower income segment of the population that lives farther from the job centers and the segment that uses transit the most. Considering the discounts in transfers, the general population will benefit from a 5.1% reduction in the average cost of a transit fare.

*Environmental co-benefits.* The reduction in the size of the transit fleet, the improvement in the emissions standards and the technological change will reduce the emissions of local pollutants. The economic benefit of reducing one ton of Particulate Matter (PM) in Bogotá was estimated in the Decennial Plan for the Reduction of Air Pollution in Bogotá (PDDAB, 2010) at USD 485,000. This estimate includes the cost associated to deaths, respiratory diseases and productivity. Estimations show that using a 12% discount rate, the NPV of the reductions in PM emissions amounts up to USD 331 Million. Besides these co-benefits in emissions reductions, hybrid and electric technologies are also expected to reduce noise levels too.

*Gender benefits.* The SITP will address concerns regarding the perception of safety in public transport in Bogotá. The existing transit system sometimes presents as a hazard due to the frequently reckless behavior of drivers who are competing for passengers in the streets. It is understood that women perceive the safety issues in transport at a greater extent than men. The formalization of the transit system in Bogotá and the use of bus stops and terminals for interchanges will ameliorate some of the safety concerns as passengers will be able to wait for buses in a controlled and sheltered environment. Additionally, the integrated fare system will use contact-less smart cards which will eliminate the use of cash as a means for paying fares. This may also decrease the opportunities for criminal activity inside the buses. In general, the SITP will provide a safer and more secure environment for public transport passengers.

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<sup>4</sup> Except for the Transmilenio system where transfers are integrated

<sup>5</sup> Currently the cost of a transit fare is \$1,400 Colombian Pesos (COP). In the SITP, the cost of a transit fare will remain the same and transfer will only be \$300 COP

*Other Benefits.* Besides the benefits outlined above, the proposed program is also expected to achieve the formalization of bus drivers, guaranteeing employment benefits such as pension and health care, and limiting the number of working hours per day. These conditions are expected to considerably increase the quality of life of drivers and increase also tax revenue due to the formalization of the transportation business. Additionally, drivers will be pay on a monthly instead of a per passenger basis, eradicating dangerous driver behavior known as “Penny-war”, and consequently improving road safety.

## **6. Implementation Potential**

*Country and sector strategies:* Through the National Urban Transport Program (NUTP), the Government of Colombia designed a policy to improve urban public transport systems in major cities. The policy framework aims to i) Improving the efficiency and safety of the public urban transport services, ii) Provide reliable transportation accessibility for low-income populations; iii) Encourage private sector participation in the provision of services iv) Reduce air pollution and emissions of greenhouse gases, v) Promote comprehensive processes for sustainable urban development, and vi) respond to climate change challenges. The NUTP has supported the development of transport systems in large cities (> 600,000 inhabitants) and medium (250.000 to 600.000 inhabitants) since 2003. The planning responsibilities of the NUTP reside in the National Planning Department (DNP) and the implementation responsibilities lie in the Ministry of Transport.

In addition to the NUTP’s direct support to public transport development, the Ministry of Environment, Housing and Territorial Development Policy has developed the Policy for Prevention and Control of Air Pollution, under which recent regulation has been developed to mitigate local and GHG pollutants. In particular, Resolutions 601 (2006), 910 (2008), 909 (2008) and 2604 (2009) enacted provisions regarding air quality standards such as an improvement in the quality of diesel fuel and emission standards for stationary sources and emission standards for mobile sources including public transport vehicles. As a result of the air quality policy a permanent reduction in tariffs was enacted, reducing import tariffs of hybrid and electric buses and trucks from 15% to 5% through Decree 2658 (2011).

*Institutional and implementation arrangements:* Transmilenio S.A. is in charge of the SITP implementation and the supervision of the concession contracts. Transmilenio S.A. is the public agency which has been in charge of developing the Bus Rapid Transit system in Bogotá through the last 13 years and has ample experience in managing the transport operation contracts of the trunk-and-feeder system. The agency has a broad technical and managerial capacity in technical, environmental, technological and procurement matters. It is organizationally housed under the Secretariat of Mobility and its operational expenses are financed by a small share of fare collection revenue. Transmilenio is supporting the technological transformation of the system and is supported in this regard by the Secretariat of the Environment.

Bancóldex will be the agency in charge of implementing the CTF funds dedicated to financing the acquisition of clean technology buses. Bancóldex will act as a source of funding for Local Financing Institutions, who in turn will directly finance the SITP concessionaires with loans. Bancóldex has the mandate and financial and operational capabilities required for implementation. The institution: i) has been established to promote foreign trade and business development through the provision of finance, ii) is governed by the Law on Banks and Financial

Institutions, and iii) functions as a second-tier bank using IFLs to channel its resources and meet the credit needs of all economic sectors iv) has the fiduciary and operational capacity required for the successful implementation of the program, v) is solvent and boasts practices of risk management, vi) has been an effective executing IDB programs, and vii) the government has chosen as one of the organizations that support their efforts to reduce GHG emissions.

*Sustainability:* The SITP is arguably the most important transport initiative in Bogotá. After the initial success of Transmilenio in the 2000's the city started planning for a solution that would involve not only the high-demand transit corridors but all the transit service in the city under an integrated scheme. The IDB has been an active partner supporting this project and has provided financing for the design of the system in 2008. The successful implementation of this program is a priority for the City and its long term viability is supported by the existing concession contracts that dictate the rights and obligations of transport operating companies. As mentioned above, Transmilenio S.A. is in charge of overseeing these contracts and has experience over the past 13 years managing the operation contracts of the trunk and feeder system.

*Resource mobilization:* The CTF funds are co-financing all the SITP investments in infrastructure, vehicle renovation and technology, which account for about US\$ 1200 million over the next 20 years (Net Present Value). These investments are being financed by a combination of public resources and private financing. In particular, the vehicle renovation component amounts up to US\$840 million (NPV) which will be funded completely by the transport operating companies. Even though CTF financing is small compared to the rest of the program, it will have an impact beyond financing due to the innovative and transformational nature of the investments.

In addition to the co-financed resources, the proposed program will mobilize additional funds from Local Financial Institutions (LFI). Under the proposed program, Bancóldex and LFI's will co-finance each bus equally. This means that the US\$ 40 million program will leverage an equivalent amount, totaling US\$ 80 million. Bancóldex will act as a source of funding for LFIs, who in turn finance SITP concessionaires through credit lines. The resources will be offered with attractive financial terms to help offset the initial cost difference of clean technologies.

## **7. Additional Cost and Risk Premium.**

Incorporating and operating clean technology buses in the SITP represents additional costs and additional savings during the bus life cycle, compared to a diesel bus operation. First, hybrid and electric buses represent a higher initial cost to bus operating companies compared to diesel buses. The clean technologies are in general more expensive and, even though the prices have fallen in the last five years, there is still a gap to cover.

Some of the higher initial costs are offset during the bus operation because clean technologies broadly have lower operational costs in the case of Bogotá. Tests performed in Latin America showed that the hybrid bus operation represents reductions in fuel costs. Similar tests showed that electricity costs of operating electric buses are also lower compared to fuel costs in diesel buses. The cost of maintenance, lubricants and tires also varies across technologies.

Another difference between the operation of diesel, hybrid and electric buses in the SITP is the revenue model. According to the concession contracts, bus operating companies are paid for the operation of a bus based on three factors:

- a. Investment (Cost of the bus)
- b. Demand (Number of boarded passengers)
- c. Distance (Km operated)

Considering that the hybrid and electric buses represent a higher investment, the SITP is expected to financially reward the operation of clean technologies at higher rates than the diesel buses. Demand and distance are expected to remain constant and independent of the technology that is operated.

**Table 2: Changes in cost variables across the technologies in the SITP<sup>6</sup>**

Cost Variable	Diesel	Hybrid	Electric
Initial Costs	US\$ 180,000	US\$ 290,000	US\$ 250,000 *
Fuel/electricity costs	US\$ 0.32/km	-35%	-60%
Lubricants	US\$ 0.03/km	+50%	-40%
Tire wear	US\$ 0.03/km	Neutral	+15%
Maintenance	US\$ 0.20/km	+25%	-50%
Battery lease	--	-	US\$ 0.18/km
Yearly remuneration	100% **	+17%	+8%

\* The cost does not include the cost of the battery. Manufacturer offer the batteries on a lease, where the manufacturer guarantees the battery and replaces in the event of any problem.

\*\* Estimations of the yearly remuneration were made based on information shared by SITP concessionaires and Transmilenio S.A. The remuneration figure is not shown for confidentiality purposes.

Based on these figures, a financial model was developed to analyze the profitability of the operation of each type of technology. This model simulates the cash flow of an SITP operator that acquires a bus and operates it under the conditions of the SITP contracts, over a time span of 12 years (current age limit for a diesel bus). It considers costs of capital, labor, maintenance, taxes and financial costs. This model was prepared based on IDB research and discussions with Transmilenio S.A., SITP concessionaires, local academic institutions and commercial banks. Results of the model are shown below:

**Table 3: Financial indicators of a bus operation per technology under the existing financial conditions**

Indicator	Diesel	Hybrid	Electric
Internal Rate of Return	32.02%	28.78%	22.35%
Net Present Value	US\$ 43,013	US\$ 65,933	US\$ 44,685
Recovery Period (yrs)	2.4	2.64	8.6

<sup>6</sup> Source data: IDB market research and interviews with bus operation companies and Transmilenio S.A.

As shown by the model, the hybrid and electric bus operations are highly profitable and could be attractive for an external investor. However, the rate of return of a diesel bus is still the highest under the existing financial and contractual conditions. This signals that the incorporation of clean technologies is currently unlikely unless other incentives are enacted to increase their profitability. Therefore, an analysis was done to estimate the impact of CTF concessional conditions<sup>7</sup> in the bus operation cash flow. Results of the simulation are shown in the table below

**Table 4: Financial indicators of a bus operation per technology considering the CTF concessional conditions for the financing of hybrid or electric buses**

Indicator	Diesel	Hybrid	Electric
Internal Rate of Return	32.02%	31.96%	25.08%
Net Present Value	US\$ 43,013	US\$ 73,253	US\$ 51,285
Recovery Period (yrs)	2.4	2.53	6.2

Results show that, on one hand, introducing a CTF concessional rate for the acquisition of clean technology buses would equalize the rate of return of incorporating hybrid buses into the SITP. The investment recovery period for hybrid buses would be mostly similar to the current diesel bus operation. On the other hand, incorporating electric buses would still yield lower rates of return than diesel buses and the recovery period would be four years longer.

The aim of this program is to provide a financial incentive for the acquisition of clean technologies in the SITP. The analysis shows that this incentive would bring hybrid buses to the levels of profitability that a concessionaire currently perceives through diesel bus operation. Electric buses are still a more expensive technology and under these conditions the profitability would still be lower than the diesel alternative. Nevertheless, the cost of electric buses has fallen dramatically in the last five years and it is likely that this trend continues, increasing the likelihood of being incorporated in the SITP during the period of disbursement of the program.

The results of this model have been shared with the city of Bogotá. Both Transmilenio S.A. and the Secretariat of the Environment are actively engaged in dialogue with SITP concessionaires and with hybrid and electric bus manufacturers in order to generate the adequate business environment for the incorporation of clean technologies. The IDB is continuously supporting these activities with technical cooperation funds, as indicated in the main project document. Currently, the City is evaluating the possibility of developing additional financial and regulatory incentives to complement the CTF concessional resources and increase the attractiveness of the clean technology bus operation.

<sup>7</sup> The CTF concessional conditions are: 0.25% interest rate, 40 year repayment period, 10 year grace period. However the actual conditions that the SITP concessionaires perceive will be different and will depend on the associated transactional costs of Bancóldex and the Local Financial Institutions. The model considers these costs and was developed together with Bancóldex in order to estimate the adequate rates that would be perceived by SITP concessionaires.

## 8. CTF Indicators

Co-financing Indicators and Targets		
Core Indicators	Targets	Comments
Increased finance for low-carbon development mobilized (USD)	USD 40,000,000	Under the proposed program, Bancóldex and LFI's will co-finance each clean technology bus on equal shares. This means that the \$ 40 million program will leverage an equivalent amount, totaling US\$80 million. See section 1 of the document.
GHG emission reductions (Ton CO <sub>2</sub> e / year)	92,308 Tons	The implementation of the CTF co-financed investments will result in direct GHG emissions reductions of 92,308 metric tons of carbon dioxide equivalent per year (tCO <sub>2</sub> e/year) and 2.2 Million tCO <sub>2</sub> e over 24 years <sup>8</sup> . The implementation of CTF co-financed investments will have a significant impact reducing Bogota's public transport CO <sub>2</sub> emissions, as a result of: (i) Reduction in the total size of the bus fleet from 16,000 to 9,900 vehicles; (ii) Optimization of the transit routes; (iii) Reduction of the average age of the fleet; (iv) Technological improvement to EURO IV Diesel engines and hybrid and electric buses. See section 2 of the document.
Increased number of people with access to low-carbon public transport (Amount)	1,239,000	This indicator takes into account that currently (2013) Transmilenio --a low- carbon transportation system-- carries out 1.775.933 trips a day. With the full implementation of the SITP throughout the city (2017), there will be an additional 2,725,771 daily trips carried out by improved, low-carbon transportation systems. The estimation of the proposed indicator considers that in Bogotá the trip rate is 2.2 daily trips per person.
Development Indicator(s):	Targets	Comments
Reduction in operating cost of public transportation in Bogotá. (USD / year)	USD 33,000,000	This indicator shows the yearly reductions in operating costs. It takes into account savings in fuel, labor and maintenance that result from reducing vehicle supply and from the technology improvement of Bogotá's buses through the full implementation of the Integrated Public Transportation System (SITP by its Spanish acronym) and a pilot fleet of clean technology buses..
Reduction of local pollutants of particulate matter (PM) released by Bogotá's public transportation system. (million Ton / year)	216	This indicator shows the yearly reductions in local pollutants. It takes into account particulate matter (PM) abatement resulting from both the reduction of the number of conventional vehicles and improvements in bus technology in Bogotá through the full implementation of the SITP and the pilot fleet of clean technology buses.

<sup>8</sup> Idem 2