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REVISED
CLEAN TECHNOLOGY FUND
INVESTMENT PLAN FOR COLOMBIA

April 2013

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ACRONYMS

Bancoldex	<i>Banco de Comercio Exterior de Colombia</i> (Foreign Trade Bank of Colombia)	IIC	Inter-American Investment Corporation (part of IDB Group)
BAU	business as usual	IP	Investment Plan
BRT	bus rapid transit	LCD	Low Carbon Development
CCI	Clinton Climate Initiative	LAC	Latin America and the Caribbean
CNG	compressed natural gas	LFI	local financial institution
CO ₂	carbon dioxide	M	million
CO ₂ e	carbon dioxide equivalent (A unit used to measure the climate effects of all GHG; it is calculated by multiplying the quantity of a GHG by its global warming potential)	MDB	multilateral development bank
		MIF	IDB's Multilateral Investment Fund
		Mt	million tons
CONPES	<i>Consejo Nacional de Política Económica y Social</i> (National Council for Economic and Social Policy)	NCRE	non-conventional renewable energy
		PM	particulate matter
		PND	Plan Nacional de Desarrollo (National Development Plan)
COP	Colombian Peso	PNTU	<i>Política Nacional de Transporte Urbano y Masivo</i> (National Urban Transport Policy)
CREG	<i>Comisión Reguladora de Energía y Gas</i> (Energy and Gas Regulatory Commission)	POT	<i>Plan de Ordenamiento Territorial</i> (land-use plan)
CTF	Clean Technology Fund	PPA	power purchase agreement
CTIMCC	<i>Comité Técnico Intersectorial de Mitigación de Cambio Climático</i> (Inter-sectoral Technical Committee on Climate Change Mitigation)	PPP	Alianzas público privadas (private-public partnerships)
		RE	renewable energy
DNP	<i>Departamento Nacional de Planeación</i> (National Planning Department)	SETP	<i>Sistemas Estratégicos de Transporte Público</i> (Strategic Public Transport Systems) (for medium-sized cities)
ECDBC	<i>Estrategia Colombiana de Desarrollo Bajo en Carbono</i> (Colombian Low-Carbon Development Strategy)	SIN	Sistema Interconectado Nacional (National Interconnected System)
		SITM	<i>Sistemas Integrados de Transporte Masivo</i> (Integrated Mass Transit Systems) (for large cities)
EE	energy efficiency	SITP	<i>Sistema Integrado de Transporte Público</i> (Integrated Public Transport System)
ENSO	El Niño-Southern Oscillation	SMEs	small and medium-sized enterprises
EPM	<i>Empresas Públicas de Medellín</i> (Medellín Utilities)	t	ton
ESCO	energy services company	TDM	travel demand management
GDP	gross domestic product	UNFCCC	United Nations Framework Convention on Climate Change
GHG	greenhouse gases	Uniandes	Universidad de los Andes
GoC	Government of Colombia	UPME	<i>Unidad de Planeación Minero-Energética</i> (Mining and Energy Planning Unit)
IBRD	International Bank for Reconstruction and Development (World Bank)	ZNI	<i>Zonas No Interconectadas</i> (Non-Interconnected Zones)
IDB	Inter-American Development Bank		
IDEAM	<i>Instituto de Hidrología, Meteorología y Estudios Ambientales</i> (Institute of Hydrology, Meteorology, and Environmental Studies)		
IFC	International Finance Corporation		

EXECUTIVE SUMMARY

This note revises the Clean Technology Fund (CTF) Investment Plan (IP) for Colombia. The Trust Fund Committee (TFC) of the CTF endorsed the CTF Investment Plan for Colombia in the meeting held in March 15 – 16, 2010, with an envelope of up to US\$150 million in CTF funding.

These CTF funds will finance and catalyze greater investments in sustainable urban transport systems and energy efficiency projects, as well as in non-conventional renewable energy. As of April 2013, US\$37.7625 million of CTF funding have been committed by the TFC.

The areas of intervention (two priority sectors) of the original CTF Investment Plan for Colombia remain unchanged. However, the GoC proposes to bring in the first phase of the IP the non-conventional renewable energy sector as a third priority. This third sector was presented in the original CTF IP as a priority sector for a possible second phase of the IP. This priority will be financed through the reallocation of CTF first phase IP resources. The GoC's intention is to commit the US\$150 million CTF total funding by Q3-2014. The impact of the revised programs on CTF objectives is expected to be comparable to the one envisioned in the original CTF Plan.

- *Program 1 – Sustainable Urban Transport (IBRD, IDB):* The first project approved by TFC (August 2011) was the support to Strategic Public Transport Systems (SETPs) in seven of Colombia's medium-sized cities. It is expected that the SETPs project will receive its first disbursement on Q1-2014 out of the US\$ 20 million CTF approved loan. Bogotá's Integrated Public Transport System (SITP) US\$ 40 million IDB project has been under preparation and will be presented for TFC approval by Q3-2013. Finally the remaining US\$ 40 million CTF funds, originally allocated exclusively for the IBRD Bogotá's SITP project (plus US\$ 1 million proposed by GoC to be reallocated to this project) will be applied to a select group (one or two) of Colombia's largest cities as a way to accelerate the implementation of their respective SITPs, and possibly to achieve additional greenhouse gas (GHG) reductions.
- *Program 2 – Energy Efficiency (IDB, IFC):* The US\$ 17.5 million IDB/IFC Colombia's Sustainable energy Finance Program (C-SEF) was approved by the TFC in December 2010 (first TFC project approval for Colombia's IP). In November 2012 a US\$ 262,500 Preparation Grant for Bancoldex Energy Efficiency Financing Program was approved by TFC. In April 2013, the US\$ 10.7875 million CTF-IDB Energy Efficiency Financing Program for the Services Sector (the Bancoldex Energy Efficiency Financing Program) was submitted for approval to the TFC. Other two energy efficiency projects (one addressing the residential sector, and the other the energy services companies, or ESCOs) are in preparation. Finally, GoC proposes to reallocate US\$ 11 million of this Program. These resources is proposed to be assigned as follows: (i) US\$ 1 million to the Sustainable Urban Transport Program, and (ii) US\$ 10 million to a third Program, proposed in this Revision Note to the TFC by the GoC, for interventions in the third priority sector on non-conventional renewable energy. Even though a reallocation of resources is proposed, the Energy Efficiency Program is expected to have the same original program results.
- *Program 3 – Non-conventional Renewable Energy (IDB):* This GoC's proposed new Program is aimed to promote a larger presence in the energy market for non-conventional renewable energy (NRCE) sources. CTF funds, blended with other sources, will contribute to investments that will provide information and the experience required to catalyze a larger adoption of a particular NCRE technology. It will also help to overcome the information barriers that prevent a larger presence in the market of NCRE and serve the purpose to position alternative energy generation

sources contributing to keep the countries power matrix in a relatively low-level of GHG emissions.

Expected Results Indicators

The summary of expected results is presented on Table 1, while the expected results by program are presented on Table 2 (Sustainable Urban Transport), Table 3 (Energy Efficiency), and

Table 4 (Non-Conventional Renewable Energy).

Estimated cost-effectiveness values for the three programs are as follows:

- For Sustainable Urban Transport: US\$45.39/ton for the entire financing, or about US\$4.32 of CTF resources/ton.
- For Energy Efficiency: US\$30.04/ton for the entire financing, or about US\$7.96 of CTF resources/ton.
- For Non-Conventional Renewable Energy (20MW wind powered plant): US\$115.79/ton for the entire financing, or about US\$26 of CTF resources/ton.
- For Non-Conventional Renewable Energy (20MW + 413MW (possible expected additional)): US\$5.42/ton for the entire financing, or about US\$ 1.23 of CTF resources/ton.

Table 1. Summary of Revised Expected Result Indicators

Summary Result Indicators	Target Value (Original CTF IP)	Target Value (Revised CTF IP)
Co-financing of CTF funding (US\$ million)	150	150
Leveraged co-financing (\$US million)	2.879,8	1.103,3
GHG emissions savings (Mt/CO ₂ e)/year)	77	36,42
CTF Cost Effectiveness (CTF US\$/tCO ₂ e reduction over 20 years)	1.95	4,1

Table 2. Expected Result Indicators for the Sustainable Urban Transport Program

Indicators	Baseline	Investment Program Results ¹
Implementation of integrated public transit systems (SITM) ⁽²⁾	3 SITMs implemented (2010 baseline)	Bogotá's SITP fully implemented targeting a population of 7 million. One or two SITPs fully implemented in Colombia's largest cities targeting a population of 1.5 million ⁽³⁾ SETPs implemented in seven cities, targeting a population of 2.4 million
Annual GHG emissions from the transport sector in target areas	21.8 Mt CO ₂ per year	Annual emission at 20.6 Mt CO ₂ per year, reflecting a 1.2 Mt CO ₂ e reduction per year. Cumulative (avoided) reductions of 23.4 Mt CO ₂ e by 2030 (46.8 Mt CO ₂ e by 2050) <ul style="list-style-type: none"> • Bogotá's SITP annual emission reductions of 0.4Mt CO₂e • One or two SITPs (out of seven SITPs) annual emission reductions: One SITP of 0.06 Mt CO₂e or Two SITP of 0.08 Mt CO₂e⁽⁴⁾ • Seven SETPs annual emission reductions of 0.1 Mt CO₂e • Initial implementation of low-carbon bus technology in the SITP and SETPs contributing to additional reductions of 0.2 Mt CO₂ per year Additional reduction of 0.39 Mt CO ₂ e per year is expected from replication and scale-up in SITPs (four or five remaining cities after selection)
Introduction of low-carbon bus technologies in the transit systems	Standard diesel buses	Bogotá's SITP and SETPs start initial implementation of an advanced hybrid fleet, or other low-carbon bus technologies
Modal shift from private vehicles to public transit systems	Increased ownership and use of private vehicles	Modal share of public transport grows or remains stable

- (1) The final figures of investment results column are based on calculation of MT and DNP and the on-going Low Carbon Development Study LCDS of World Bank and DNP, as well as the Uniandes (Grupo SUR) and Clean Air Institute. 2012 Study. "Estrategias Ambientales Integradas para una Movilidad Sustentable in Bogotá, and the Uniandes (Grupo SUR) + Secretaria de Ambiente de Bogotá. 2010 Study "Plan Decenal de Descontaminación del Aire de Bogotá"
- (2) Integrated public transit system concept builds on implemented SITM and SETP to reorganize public transport integrating all other transport modes of a large city/ metropolitan area.
- (3) This targeted population corresponds to a possible selection of 2 cities out of seven largest cities with the least CO₂e potential, in order to remain conservative in the analysis. The target depends on the final city selection.
- (4) Selection of one or two SITPs will be done after expected CTF approval. Calculations for one SITP with 0.06 MtCO₂e abatement target corresponds to the average abatement potential of the six SITPs (six largest cities). Calculations for two SITPs with 0.08 Mt CO₂e abatement target corresponds to a possible selection of the cities with least abatement potential.

Table 3. Expected Result Indicators for the Energy Efficiency Program

Indicators	Baseline	CTF Efficiency Program Results
National electricity consumption	117,000 GWh per year (2030)	115,916,6 GWh per year (2030)
CTF Cost-effectiveness (CTF US\$/t CO ₂ e reduction over 20 years)	n/a ¹	7,96
GHG emissions from electricity generation	36 Mton CO ₂ e per year (2030)	35.76 Mton CO ₂ e per year (2030)

¹ Abbreviation for not applicable

Table 4. Expected Result Indicators for the Non-Conventional Renewable Energy Project

	Indicators	Baseline	CTF NCRE Project Results
Co-financing of CTF funding (US\$ million)		0	10
Leveraged co-financing (\$US million)		n/a	34
RE installed capacity (MW)		0	20
GHG emission reductions (MtCO ₂ e/year)		0	0,019
GHG emissions savings (Mt/CO ₂ e) over 20 years (2030)		n/a	0,38
CTF Cost-effectiveness (CTF US\$/t CO ₂ e reduction over 20 years)		n/a	26
Additional possible potential GHGs reduction by substituting a 300MW coal thermal plant:	Wind powered plants (MtCO ₂ e/year)	n/a	0,32
	Wind powered plants (MtCO ₂ e over 20years (2030))	n/a	7,74
	RE/wind installed capacity (MW)	n/a	413
	Geothermal powered (MtCO ₂ e/year)	n/a	0,32
	Geothermal powered plants (MtCO ₂ e over 20 years (2030))	n/a	6,16

Revised Financing Table and Approval Calendar

Table 5 summarizes the allocations by MDB. Table 6 shows the revised financing plan, including co-financing. Finally, Table 7 shows the allocations and milestone dates for each project.

Table 5. Proposed Reallocation of CTF Resources. April 2013 Revision

CTF Program	CTF Funding (CTF Plan Endorsed March 2010)	CTF Funding Reallocation			CTF Funding (Revised CTF IP, April 2013)
		IDB	IBRD	IFC	
Colombia Sustainable Urban Transport System	100		(+) 1		101
Energy Efficiency	50	(-) 0.24		(-) 10.76	39
Non-conventional Renewable energy Program	0	(+) 10			10
Total	150	(+) 9.76	(+) 1	(-) 10.76	150

Figures in US\$ million

Table 6. Colombia Revised CTF IP, April 2013 - Indicative Financing Plan

Financing Source	Sustainable Urban Transport	Energy Efficiency	Non-Conventional Renewable Energy	TOTAL
CTF executed by IDB	60.0	32.26	10.0	102.26
CTF executed by IBRD	41.0	--	--	41.0
CTF executed by IFC	--	6.74	--	6.74
CTF total	101.0	39.0	10.0	150.0
IDB loans	300.0	10.00	10.0	320.0 *
IBRD loans	100.0	--	--	100.0 *
IFC loans	--	24.7	--	24.7
IDB grants	5.8	--	--	5.8
IBRD grants	--	--	--	--
KfW	--	--	--	--
Carbon finance	30.0	--	--	30.0
Other	--	--	--	--
GoC			--	--
Bogotá DC		--	--	--
Municipalities	100.0	--	--	100.0
Private sector	425.30	73.50	24.0	522.80
TOTAL	1,062.10	147.20	44.0	1,253.30

Figures in US\$ million

*IDB and IBRD loans are included in the country pipelines and in the medium fiscal framework.

Table 7. Colombia Revised CTF IP, April 2013 – Project Allocations and Approval Calendar

CTF Program / Project Title	MDB	TFC Approval Date	MDB Board Approval Date	Effectiveness Date/ Contract Date	First Disbursement Date	Original CTF Funding (US\$ million)	Reallocated CTF Funding (US\$ million)	Leveraged Funding (US\$ million)
Program 1: Colombia Sustainable Urban Transport						100	101	961.10
1.1 Bogotá's SITP	IDB	Q2-2013*	Q3-2013*	Q3-2013*	Q4-2013*	40	40	
1.2 Bogotá's SITP (and other major cities): Prep Grant	IBRD	Q3-2013*					1	
1.2 Bogotá's SITP (and other major cities): Loan	IBRD	Q3-2014*	Q4-2014*	Q1-2015*	Q2-2015*	40	40	
1.3 SETPs	IDB	Q3-2011	Q3-2011	Q2-2013*	Q1-2014*	20	20	
Program 2: Improving Energy Efficiency						50	39	108.20
2.1 EE in the residential sector	IDB	Q3-2013*	Q4-2013*	Q4-2013*	Q4-2013*	10	10.58	
2.2 EE in the Services Sector: Prep Grant	IDB	Q4-2012				0.2625	0.2625	
2.2 EE in the Services Sector: Program	IDB	Q2-2013*	Q2-2013*	Q3-2013*	Q1-2014*	10.7375	10.7875	
2.3 Development of an ESCO market in Colombia	IDB	Q4-2013*	Q1-2014*	Q2-2014*	Q2-2014*	5.39	4.52	
2.4 C-SEF: Loan 2	IDB	Q4-2010	Q3-2013*	Q1-2014*	Q1-2014*	5	5	
2.4 C-SEF: IDB Technical Cooperation and fees	IDB					1.11	1.11	
2.4 C-SEF: Bancolombia loan	IFC		Q2-2011	Q3-2011	Q3-2011	5.4	5.4	
2.4 C-SEF: Remaining loan balance	IFC					4.6	0	
2.4 C-SEF: IFC Technical Cooperation and fees	IFC		Q1-2011	Q1-2011	Q1-2011	1.39	1.34	
2.5 EE private sector project	IFC					6.11	0	
Program 3: Non-Conventional Renewable Energy						0	10	34
3.1 Non-Conventional Renewable Energy Program	IDB	Q4-2013*	Q1-2015	Q2-2015	Q3-2015	0	10	
TOTAL						150	150	1,103.30

* Planned

INTRODUCTION

The Clean Technology Fund (CTF) Colombia Investment Plan (IP) is a “business plan” owned by the Government of Colombia (GoC), and prepared in cooperation with the International Bank for Reconstruction and Development (IBRD), the Inter-American Development Bank (IDB) and the International Finance Corporation (IFC), in order to provide support for the low-carbon objectives contained in Colombia’s National Development Plan (2006 – 2010) discussed and adjusted by Colombian civil society through the National Planning Council, defined for this purpose by law. The IP identifies the programs that are proposed to be co-financed by the CTF jointly with the IBRD, IDB and IFC, and private sector.

The IP was submitted to the CTF Trust Fund Committee in March, 2010, as a two-phase process. The first phase addresses the implementation of abatement measures in two key sectors - energy efficiency and urban transport -, which have been identified as ready for the scaling-up of investment through use of CTF resources, and as exhibiting high potential for transformational change in terms of shifting investment patterns onto a lower carbon path. It was proposed that, as the Government took further steps toward creating an enabling environment for renewable energy, there would be opportunities for investing in this sector as part of a possible second phase of the IP, which could include as well further programs on energy efficiency and transport.

This note presents a revision of the original CTF Investment Plan of Colombia, which was endorsed by the CTF Trust Fund Committee in the TFC meeting held in March 15 – 16, 2010. Specifically,

this note provides an update of the status of project implementation under the original IP, and proposes reallocating funds within the priority sectors of urban transport and energy efficiency, and including non-conventional renewable energy sector as part of the current phase I IP for Colombia². Assessment of the impact of the proposed changes on achieving objectives and targets of the initial investment plan will be presented as well.

The originally selected CTF co-financing activities included the following:

- *Program 1 – Urban Sustainable Transport (IBRD, IDB)*: the proposed CTF co-financing will support Colombia in transitioning to the next generation of urban transport investments, by scaling up its hitherto successful efforts in promoting investments in BRTs and preventing a reversal in the strong gains in modal share of public transport. The GoC is proposing to use CTF co-financing for two discreet activities to:
 - a) accelerate low-carbon-related investments in Bogotá’s Integrated Public Transport System (SITP), with the largest potential for GHG emissions reduction; and
 - b) accelerate low-carbon-related investments in the Strategic Public Transport Systems (SETPs) for at least seven (of the twelve) medium-sized cities, and increase measures for reduction of GHGs within these plans, as well as indirectly leading to similar investments in a further five cities.
- *Program 2 – Energy Efficiency (IFC, IDB)*: the proposed CTF Energy Efficiency Program sought to strategically deploy CTF financing through a series of private and public sector interventions, using technical assistance, investment financing, and performance-based incentives to systematically reduce the barriers (financial, regulatory and knowledge) that stand in the way of scaling-up energy efficiency investments throughout the economy.

STATUS OF ORIGINAL INVESTMENT PLAN IMPLEMENTATION

The commitment of CTF funding under the CTF Investment Plan for Colombia has been slower than anticipated. The GoC celebrates the decision of bringing down the required minimum of leveraged loan funds which for Colombia was too high and became a strong barrier for initiating with more speed implementation, due to the difficulty to include the resulting high amounts in the national budget programmed accordingly Colombia’s medium term fiscal framework. As of April 2013, the Trust Fund Committee has committed US\$37.7625 million out of US\$150 million originally endorsed for Colombia (equivalent to 25% of the total endorsement).

The following table shows the status of project approval and financing allocation of the original CTF IP endorsed in March 2010.

² The non-conventional renewable energy sector was presented as possible second phase of the original IP, if resources became available and a better government driven environment was achieved.

2. New environment for a Non-Conventional Renewable Energy Sources Program

The PND 2010 - 2014 gives priority to the definition of incentives for investments in generation capacity through “alternative energy sources” and, for the first time, as a source for the national interconnected system (SIN). One of the most significant steps toward the implementation of the PND 2010 – 2014 in these topics was taken by the Energy and Gas Regulatory Commission (CREG), issuing the 148th resolution (in October 21, 2011) and establishing a methodology to determine the “energy firmness”⁸ of wind power plants. This methodology is the basis for an already defined “higher tariff” for energy producers that are able or have the technical capacity to provide on-demand energy.

This is considered to be an evolution in the right direction towards opening real possibilities for NCREs in the SIN, since concerns about the stability of the network and the capacity to deal with intermittency of NCREs have been raised in the face of the possibility of a bigger participation of such technologies in the energy matrix. Consequently, the regulatory framework has been more likely to maintain a high capacity share of hydropower complemented with a more carbon-intensive energy resource mix (likely reliant on abundant coal reserves and gas). Nonetheless, the PND 2010 – 2014, orders to work on NCREs as mentioned above. Additionally, in order to fulfill energy sector objectives, the PND orders a profound institutional reform in the energy sector. This reform is still under discussion and topics on NCRE could have an opportunity for enhanced institutional support.

Finally, as a result of GoC’s evaluation of the evolution of the implementation of the EE program, the projects that are already underway have the same potential to demonstrate and exemplify how to overcome the institutional, financial, knowledge and regulatory barriers than with the original CTF IP allocation. Consequently, a reallocation of US\$ 11 million is proposed, to take advantage of what GoC considers, as above mentioned, an opportunity to promote the NCREs in Colombia. In the next chapter a detailed description of the reallocation is presented.

The next section presents a complementary context for the proposed IP changes to include the NCRE Program.

Energy generation context in Colombia⁹

As compared to many countries, Colombia’s domestic energy generation is quite clean.¹⁰ During the last decade an average of 78% of electricity generation was based on hydropower. In terms of energy sector emissions, Colombia ranked 48th in the world and fifth in Latin America in 2005. Nevertheless, 36.6 percent of Colombia’s total emissions are produced from energy production and consumption (IDEAM, 2008), and as Colombia is a major regional exporter of fossil fuels, the role of fugitive emissions from fossil fuel production (accounted in the total energy sector’s emissions) accounts for at least 5 percent of total national emissions (IDEAM, 2008)¹¹. The economy of Colombia has become less carbon intensive during the last two decades, and currently stands at 0.43 kg CO₂e per US\$ of GDP (compared to a Latin American average of 0.52 and a global average of 0.73). Current socioeconomic and resource factors

⁸ Colombia has developed a financial mechanism to produce an economic signal to investors as a price premium on reliable installed power capacity.

⁹ Almost all the ideas and text in this section “Energy generation context in Colombia” and in the next section “Hydropower and Firm Energy in Colombia” are extracted from Background Report on the Energy Sector, prepared for the ongoing Colombia Low-Carbon Development Study”, DNP and the World Bank, Dec 2012, and modified for the purpose of the IP revision.

¹⁰ Extracted from: “Background Report on the Energy Sector, prepared for the ongoing Colombia Low-Carbon Development Study”, DNP and the World Bank, Dec 2012.

¹¹ Ibid

indicate that this trend is set to be reversed under a BAU scenario of increasing investment in transport and electricity generation characterized by higher carbon intensities.

To deal with this scenario, a first phase IP presented by Colombia and approved by the CTF included an **energy efficiency program**. As stated in the original CTF IP background, a reduction in the total amount of energy demanded by the existing system (through efficiency measures, or through the generation of electricity from renewable energy sources) can have a significant emissions reduction impact because the last marginal units of power utilized are often fossil-fuelled and have the highest emission factor. At the same time, this reduction in consumption can prevent or delay building new generation capacity which is currently slated to include a 150% increase in coal-fired capacity over the next 12 years, from the current 700 MW coal-fired generation capacity to 1,750 MW.

A possible second phase IP was intended to deal, in a complementary manner, from the supply side, with GHG emissions reductions in energy generation.

Hydropower and Firm Energy in Colombia

Similar to Brazil, Colombia's predominant source of electricity power production comes from hydropower.¹² Unlike the Brazilian system, however, only 6 percent of Colombia's hydropower plants have reservoirs with multi-year storage capacity. In fact, 15 percent of Colombian plants have run-of-river reservoirs that can be depleted in a single day, and 55 percent have reservoirs that allow monthly regulation. This modest overall storage capacity makes the system vulnerable to hydrological risks (World Bank Electricity Auctions: An Overview of Efficient Practices. 2011). In a single season, actual production of hydropower can range from 45 to 95 percent. Particularly during periodic droughts, this can pose a major problem for energy production¹³. A projected increase in the intensification of the water cycle and the possible intensification of extreme events (associated with El Niño-Southern Oscillation [ENSO] and La Niña) may raise the vulnerability of the power sector by affecting the reservoir capacity of hydropower-based plants. Early evidence of impacts of extreme events in the hydrology of major basins in Colombia is already documented by IDEAM.

In an effort to increase stability and reliability of the service the regulatory framework has incentivized the expansion of the generation capacity based mainly on large hydro and fossil fuel power sources. The Colombian government introduced a concept of "firm energy" under their energy auctions. Firm energy is basically a higher tariff given to those energy producers that are able/have the technical capacity to provide on-demand energy when it's needed most (i.e. when the water isn't running). Over the long-run, the GoC expects to increase system reliability while enabling competitive prices (by auctioning the credits). Unfortunately, under a short-term span, problems such as unexpected droughts have made the government to directly intervene, risking undermining the firm energy market. Firm energy regulation currently rewards, in the form of an "extra" subsidy, fossil fuels and discourages renewable energy development.

However, because of the above mentioned new policy directions, and with the mindset to maintain the principle of reliability", the GoC is searching for alternatives that could be more cost-effective in the future, as well as complementary to hydropower while keeping the country on a track of LCD.

This search took the government to propose in the PND 2010 – 2014 to study and give priority to non-conventional renewable energy sources. Some of the most relevant studies are mentioned below.

¹² Ibid

First, the mentioned 2012 LCD Study offers an initial interesting analysis as to the viability of investing in a wind power or geothermal powered plant. The Study proposes interventions consisting of the replacement of coal and natural gas-fired generating plants, as follows:

- Wind park in La Guajira: (i) 413 MW in 2021 to replace the generation from a 300 MW coal plant, and (ii) 480 MW in 2022 to replace the generation of a 300 MW gas plant
- A and Geothermal generation in Nariño and Huila Power (i) 175 MW in 2021 to replace the generation of a 300 MW coal plant, and (ii) 79 MW in 2022 to replace the generation of a 300M MW gas plant

Also the “Wind Energy in Colombia: a framework for market entry” (World Bank, 2010) study was developed. According to the study complementary wind and water resources have been identified in the country. Additionally the report, during times of extreme drought associated with the El Niño phenomenon, wind generation potential of the northern part of the country would be above the historical average. The study also analyzed the joint operation of a wind park and a hydropower plant of equal size, and found that the firm energy of the joint operation is greater than that of the isolated operation. The study recommended that these opportunities for joint operation be taken into consideration, which would make it possible to leverage the entry of wind parks in the electricity generation system.

In summary, the advantages that a wind park in Colombia can offer include:

- Diversification of energy generation, since it would incorporate a new technology and a new resource in electricity generation capacity;
- Complimentarily with hydroelectric generation at critical times of water supply;
- Release of non-renewable domestic energy resources (natural gas, coal and petroleum) for international markets;
- Potential for domestic technology development; and
- Evolution and development of regulatory and market schemes to promote new electricity generating technologies.

Finally, the above mentioned 2012 LCD (DNP and IBRD study) regarding geothermal energy mentions that Colombia does not have any installed geothermal capacity. However, ISAGEN has signed an agreement with the Inter-American Development Bank (IDB) to begin in 2012 the exploration of geothermal fields of the Nevado del Ruiz. The advantages of developing these projects in the country include:

- Diversification of energy generation with a resource that is considered to be renewable, highly firm, and independent of climatic variables;
- Low operating and overall costs (with leveled costs less than coal);
- High capacity factors (above 90 percent);
- The waste produced is minimal and have a smaller environmental impact than those stemming from thermal plants that use coal or natural gas.

The study concludes that “despite high installation costs, substituting geothermal plants for thermal is cheaper than substituting with wind. This is because geothermal provides a more constant supply, which is favored in a system that favors “firm energy” (i.e. constant, reliable energy during droughts when hydro is not available. Given there is an incomplete assessment for Colombia’s geothermal potential, it might not be feasible to construct plants with a MW capacity needed. If this is the case, the needed energy could be provided by wind resources”¹⁴.

¹⁴ Ibid.

Taking into account these recent studies, among other reasons mentioned above, the GoC's decision to prioritize NCRE in the last PND need to be accompanied by investments that will provide additional information and the experience required to catalyze a larger adoption of a particular NCRE technology, and overcome informational barriers that prevent a larger presence in the market of NCRE, allowing the country to keep its power matrix in a relatively low-level of GHG emissions.

Finally, as has been stated, recent GoC activities and decisions for prioritizing NCRES in the SIN are considered a relevant and positive new environment for NCRES. The GoC believes that there is an opportunity, through CTF's support in funding and promoting NCRE technology, to overcome the still standing barriers.

The proposed general concept and the transformation potential of the NCRE program are presented in Annex 1.

3. Sustainable Urban Transport Program

The GoC as stated in the PND 2010 – 2014, identified the need to extend the resulting social, economic and environmental benefits to traditional collective public transport and other modes, for municipalities and/or metropolitan areas whose population exceeds 600.000 inhabitants, through the new SITP mechanism. For this purpose GoC, through DNP, with support of the Transport Ministry, ordered the development of an SITM ex-post impact evaluation (using a World Bank's methodology), for 4 cities (Pereira, Cali, Barranquilla, Bucaramanga)¹⁵, to inform and quantify the economic, social and environmental impacts of SITMs, and to identify lessons learned. Continued support for SITM initiatives, as a first stage of these SITPs, is prioritized in the Plan, as well as continued support for the SETPs. Additionally, the PND 2010 – 2014, indicates the need to continue working in the preparation of the Sustainable Urban Transport program as part of the CTF IP for Colombia and promoting CTF concessional funding objectives.

The GoC considers that the above mentioned create an opportunity to further influence and incorporate low-carbon strategies in these initiatives.

The changes proposed to the Program are directed to increase this influence and therefore suggests that the remaining US\$ 40 million of CTF funds, originally allocated exclusively for the Bogotá's SITP IBRD project, should be applied to a selected group (one or two) of Colombia's largest cities as a way to accelerate the implementation of their respective integrated public transit systems, and to eventually achieve additional GHGs reductions. The following most relevant arguments were considered:

- The previously identified Bogotá's IBRD/SITP project called "Green Corridor" was planned to be developed on a main street in Bogota. As a result of the new development plan for Bogota, approved by the municipal council, and the new elected major of the city, who took office in January 2012, the initial vision and concept of the project's transport mode and technology, was discussed and reoriented, in favor of a tramway associated to urban sustainable development and low carbon issues, as well as to an innovative implementation strategy through public-private partnerships (PPPs)¹⁶. Bogota is specially concentrated on this last topic, in other words, financing its new project entirely through 100% private participation, taking advantage of the recently approved PPP law (law 1508/2012). With this in mind, the GoC considers that there is a strong possibility that Bogotá will develop its own SITP project, sometime in the near future, without any national government's or other agencies' support, including the additional CTF funds

¹⁵ The GoC had already done an impact evaluation of Bogotá's SITM

¹⁶ This is an on-going discussion.

(meaning without the US\$ 40 million IBRD/CTF funds) to those already scheduled to be presented for TFC approval next June 2013 (CTF funded US\$ 40 million IDB Project). The IDB/CTF project will support Bogotá's low-carbon SITP through co-financing the technological transformation of the Bus related projects of the Integrated Public Transport System. Consequently, Bogotá's GHG reduction target is expected to be fulfilled.

- Furthermore, the proposed changes, directed to include an additional selection of one or two of the largest cities in applying for the remaining US\$ 40 million, does not exclude Bogotá city: Bogotá would be included in the possible selected one or two cities if its new project offers additional GHG reductions, vis-à-vis those expected for Bogotá in the original CTF IP. Additional GHG reductions would also be achieved if any one or two of the other six largest cities are selected.
- The reorientation of the above mentioned IBRD/CTF project will accelerate low-carbon decisions for the selected SITPs and strengthen influence over the other cities¹⁷.

After the TFC's expected approval of IP changes, the Ministry of Transport will define, as soon as possible which of the largest cities will be in the group of one or two selected ones. Based on this selection IBRD will initiate project preparation of the US\$40 million SITP project. To enforce project quality and accelerate preparation, an additional US\$ 1 million support is proposed to be reallocated to a CTF project Preparation Grant for this IBRD project.

In general, it is considered that the rationale of the Program will not be changed and additional GHG emissions reduction, to those presented in the original CTF IP will most certainly be achieved.

However, according to new available data and recent studies, the potential for emissions reduction in the urban transport sector have been recalculated. Table presents the general differences:

Table 9. Expected result indicators of the Original and the Revised CTF IPs

Indicators	Original CTF Investment Plan for Colombia (March 2010)		Revised CTF Investment Plan for Colombia (April 2013)
	Baseline	Investment Program Results	Investment Program Results ¹
Implementation of integrated public transit systems	3 SITMs implemented	Bogotá's SITP fully implemented targeting a population of 7 million. SETPs implemented in seven cities, targeting a population of 2.4 million	Bogotá's SITP fully implemented targeting a population of 7 million. One or two SITPs fully implemented in Colombia's largest cities targeting a population of 1.5 million ⁽³⁾ SETPs implemented in seven cities, targeting a population of 2.4 million
Annual GHG emissions from the transport sector in target areas	21.8 Mt CO ₂ per year	Annual emission at 19.0 Mt CO ₂ per year, reflecting a 2.8 Mt CO ₂ e reduction per year. Cumulative (avoided) reductions of 56 Mt CO ₂ e by 2030 (112 Mt CO ₂ e by 2050) Bogotá's SITP annual emission reductions of 2.0 Mt CO ₂ e Seven SETPs annual emission reductions of 0.3 Mt CO ₂ e	Annual emission at 20.6 Mt CO ₂ per year, reflecting a 1.2 Mt CO ₂ e reduction per year. Cumulative (avoided) reductions of 23.4 Mt CO ₂ e by 2030 (46.8 Mt CO ₂ e by 2050) Bogotá's SITP annual emission reductions of 0.4Mt CO ₂ e One or two SITPs (out of seven SITPs) annual emission reductions: One SITP of 0.06 Mt CO ₂ e or Two SITP of 0.08 Mt CO ₂ e ⁽⁴⁾ Seven SETPs annual emission reductions of 0.1 Mt CO ₂ e

¹⁷ The remaining not selected ones.

		Initial implementation of low-carbon bus technology in the SITP and SETPs contributing to additional reductions of 0.2 to 0.5 Mt CO ₂ per year Additional reduction of 1.5 Mt CO ₂ e per year is expected from replication and scale-up in SITMs (seven cities) and SETPs (12 cities)	Initial implementation of low-carbon bus technology in the SITP and SETPs contributing to additional reductions of 0.2 Mt CO ₂ per year Additional reduction of 0.39 Mt CO ₂ e per year is expected from replication and scale-up in SITMs (four or five remaining cities)
Introduction of low-carbon bus technologies in the transit systems	Standard diesel buses	Bogotá's SITP and SETPs start initial implementation of an advanced hybrid fleet, or other low-carbon bus technologies	Bogotá's SITP and SETPs start initial implementation of an advanced hybrid fleet, or other low-carbon bus technologies
Modal shift from private vehicles to public transit systems	Increased ownership and use of private vehicles	Modal share of public transport grows or remains stable	Modal share of public transport grows or remains stable

By 2030 the cumulative emission reductions resulting from a sustainable low-carbon transport strategy implementation in Colombia could result in about 1.2 Mt CO₂e per year abatement. The emission reductions that would result from Bogotá's SITP are estimated at 0.4 Mt CO₂e per year, serving about 5 million passengers per day. Expected abatement of 0.08Mt CO₂e per year corresponds to a selection for SITP projects for two out of the seven largest cities. This target corresponds to a possible selection of the two cities with the least GHG abatement potential. Moreover, the seven SETPs are expected to abate up to 0.1 Mt CO₂e per year, serving an aggregate of one million passengers per day. Emission reductions brought by the SITP and SETPs will come in part by investing in dedicated infrastructure, optimizing and rationalizing bus transit services (with better technology), removing redundant vehicles (oversupply), and enabling fare and operational integration among different transit modes. Additional 0.2 Mt CO₂e per year in reductions could be achieved if low technology vehicles are implemented in the SITP and SETPs. An additional reduction of 0.39 MtCO₂e per year is expected from replication and scale-up in existing SITMs (seven cities).

Subject to the approval of this revised IP by the TFC, the next steps for this program would be as follows:

- The Ministry of Transport communicates the selected one or two cities for SITP support by CTF.
- IBRD supports project design and preparation.
- Project is presented to the TFC for approval as indicated on table 1 (Q3-2014).

4. Energy Efficiency Program

As mentioned above, it is considered that reallocating US\$11 million to finance the proposed third priority Program, the Non-Conventional Renewable Resources Program, will yield the same already underway have the same potential to demonstrate and exemplify how to overcome the institutional, financial, knowledge and regulatory barriers than with the original CTF IP allocation.

However, according to new available data and recent studies, the potential for emissions reduction in the energy efficiency sector have been recalculated. Table presents the general differences:

Table 10. Expected result indicators of the Original and the Revised CTF IPs

Indicators	Baseline	Original CTF IP (March 2010) Program Results	Revised CTF IP (April 2013) Program Results
National electricity consumption	117,000 GWh per year (2030)	112,000 GWh per year (2030)	115,916.6 GWh per year (2030)
CTF Cost-effectiveness (CTF US\$/t CO ₂ e reduction over 20 years)	n/a ¹⁸		7,96
GHG emissions from electricity generation	36 Mton CO ₂ e per year (2030)	34.4 Mton CO ₂ e per year (2030)	35.76 Mton CO ₂ e per year (2030)

5. Summary

Considering the combined new opportunities for GHG abatement in the sustainable urban sector and in NCRE technologies, the following general changes in the original CTF IP for Colombia are requested (the changes will be detailed in the next chapter):

1. Add to the prioritized sectors of the original CTF IP a third priority sector: NCREs.
2. Modify the project for the remaining US\$ 40 million of CTF funds, originally allocated exclusively for the IBRD Bogotá's SITP project, to enable it to be applied to a select group (one or two) of Colombia's largest cities, as a way to accelerate the implementation of their respective integrated public transit systems, and possibly to achieve additional GHG reductions.
3. Finance the above mentioned activities by reducing the allocation in the energy efficiency sector.

¹⁸ Abbreviation for not applicable

PROPOSED CHANGES TO THE INVESTMENT PLAN

As mentioned before the original CTF IP for Colombia was presented and endorsed as a two-phase process. The first phase addressed the implementation of abatement measures in two key sectors, energy efficiency and urban transport, which had been identified as ready for the scaling-up of investment through use of CTF resources, and as exhibiting high potential for transformational change in terms of shifting investment patterns onto a lower carbon path. Additionally, it was proposed that, as the Government would take further steps toward creating an enabling environment for renewable energy, there would be opportunities for investing in this sector as part of a possible second phase of the IP, which could include as well programs on energy efficiency and transport.

The GoC proposes to bring in to the first phase, as a third priority sector, the non-conventional renewable energy sector (NCRE), as well as to initiate project preparation of the US\$40 million IBRD CTF Bogotá's SITP modified as to enable other, one or two selected large cities (more than 600,000 inhabitants) to utilize these CTF resources.

The proposed general changes to the original CTF Colombia Investment Plan are expressed on Table . The required resources for the NCRE program is US\$ 10 million¹⁹ (details presented in Annex1), and the required additional resources for CTF/IBRD modified SITP project preparation is US\$1 million. The GoC proposes to finance the above mentioned through the reallocation of resources of the Energy Efficiency Program.

Table 10. Proposed Reallocation of CTF Resources. April 2013 Revision (US\$ million)

CTF Program	CTF Funding (CTF Plan Endorsed March 2010)	CTF Funding Reallocation			CTF Funding (Revised CTF IP, April 2013)
		IDB	IBRD	IFC	
Colombia Sustainable Urban Transport System	100		(+) 1		101
Energy Efficiency	50	(-) 0.24		(-) 10.76	39
Non-conventional Renewable energy Program	0	(+) 10			10
Total	150	(+) 9.76	(+) 1	(-) 10.76	150

Figures in US\$ million

As a result of this requested change, the Colombia Revised CTF IP would be as follows (Table 8):

¹⁹ Annex 1 presents the project on "Promotion of Privately Operated, Medium Scale Commercial Non-Conventional Renewable Energy (NCRE) Power Generation plant".

Table 8. Colombia Revised CTF IP, April 2013 - Indicative Financing Plan

Financing Source	Sustainable Urban Transport	Energy Efficiency	Non-Conventional Renewable Energy	TOTAL
CTF executed by IDB	60.0	32.26	10.0	102.26
CTF executed by IBRD	41.0	--	--	41.0
CTF executed by IFC	--	6.74	--	6.74
CTF total	101.0	39.0	10.0	150.0
IDB loans	300.0	10.00	10.0	320.0 *
IBRD loans	100.0	--	--	100.0 *
IFC loans	--	24.7	--	24.7
IDB grants	5.8	--	--	5.8
IBRD grants	--	--	--	--
KfW	--	--	--	--
Carbon finance	30.0	--	--	30.0
Other	--	--	--	--
GoC			--	--
Bogotá DC		--	--	--
Municipalities	100.0	--	--	100.0
Private sector	425.30	73.50	24.0	522.80
TOTAL	1,062.10	147.20	44.0	1,253.30

Figures in US\$ million

*IDB and IBRD loans are included in the country pipelines and in the medium fiscal framework.

POTENTIAL IMPACTS OF PROPOSED CHANGES ON INVESTMENT PLAN OBJECTIVES

CTF Investment Criteria

The overall impact expected from the proposed Revised CTF IP, is comparable to the impact expected in the original CTF Plan. Effects of the proposed changes are shown on Table 9 and Table 10, according to the criteria established in the original CTF IP.

Table 9. Assessment of Proposed Changes, Sustainable Urban Transport

CTF Investment Criteria	Original CTF IP (March 2010)	Revised CTF IP (April 2013)
<i>Transformative impact</i>	The transformative impact of the CTF Transport Program will be achieved through combining policy reform and institutional capacity development packages, alongside CTF co-financing aimed at reducing the cost of measures for reducing GHG emissions within urban transport investment plans. As the success of these approaches is demonstrated, there should be a further integration of low-carbon investments within the National Urban Transport Policy (PNTU), ensuring that future plans and investments support low-carbon development of the sector. Over the 20-year lifetime of the Program investments, the cumulative reductions of the CTF investment program could be around 56 Mt CO ₂ e.	The transformative impact of the Revised CTF Transport Program will be achieved in the same way as in the original CTF Transport Program. Over the 20-year lifetime of the Revised Program investments, the cumulative reductions of the CTF investment program were recalculated and could be around 23.4 Mt CO ₂ e.
<i>Cost-effectiveness</i>	Cost effectiveness of reductions is estimated at US\$38.8/ton for the entire financing, or about US\$1.8 of CTF resources/ton.	Cost effectiveness of reductions is estimated at US\$45.30/ton for the entire financing, or about US\$4.32 of CTF resources/ton.
<i>Potential for GHG Emissions Savings</i>	According to available data, by 2030 sustainable, low-carbon transport strategies in Colombia could result in about 2 Mt CO ₂ e per year of abatement.	According to recent available data, by 2030 sustainable, low-carbon transport strategies in Colombia could result in about 1.2 Mt CO ₂ e per year of abatement.
<i>Replication and scalability potential.</i>	The implementation of Bogotá's SITP at the proposed scale can stimulate a second generation of urban transport systems in Colombia, both in the SITMs (of seven large cities) and in the SETPs (of 12 medium-sized cities). The proposed CTF co-financing for the Bogotá SITP and SETPs in seven cities will leverage local public funding and multilateral debt financing. The impact of the CTF investments will therefore have a replication effect on the SITMs of other large cities, as well as the SETPs of five other medium-sized cities. Successful integration of low-carbon measures into the initial implementation of these seven SETPs will positively influence the PNTU and encourage the Government to introduce similar measures into all urban investment plans in the future. The implementation of these measures will have a transformation effect on all new urban areas within Colombia expected to grow over the coming decades and subject to implement a sustainable urban transport system under the PNTU.	The proposed changes will enforce the replication and scalability potential estimated for the original CTF Plan, considering that new SITP projects in one or two of the largest cities will increase replication and scalability potential adding on Bogotá's SITP as well as the programmed SETPs. Information on this experience has been asked for by other Latin-American countries and other countries as Egypt, Turkey, South Africa, Indonesia and Vietnam.

Implementation Potential	<p>In the larger cities, there is a strong and long track record of implementing SITMs among the national and local governments. Since 2005, the IBRD and the IDB have supported the implementation of SITMs by providing more than one billion dollars of investment loans. While there will no doubt be significant implementation challenges in implementing SETPs in medium-size cities, the capacity already built in Colombia to address these challenges is significant. Technical and feasibility studies for Bogotá's SITP are almost completed and have been financed, in part, through IDB technical cooperation operations. The IDB is also supporting the development of an integrated land-use and transport planning strategy for the city, including the reformulation of the regulation that establishes the financial and management land-based instruments. Furthermore, design and feasibility studies for seven SETPs are under execution with IDB support.</p>	<p>Proposed changes have the same implementation potential.</p>
<i>Development Impact and other co-benefits</i>	<p>Promoting more sustainable transport systems, such as those envisioned in the SITMs and SETPs, can provide substantial co-benefits in addition to climate change mitigation, including reductions in traffic congestion (from reduced travel time) and improvements in public health (from reduced air pollution, noise, accidents, sedentarism, and stress). Bogotá and other large cities that have implemented SITMs (Pereira and Cali) have demonstrated the potential to reduce exposure to airborne pollutants.²⁰ In Bogotá, the operation of TransMilenio has resulted in an 80% reduction in accidents along the BRT corridors, and a 3-10 decibels reduction in noise levels, as well as other development benefits.²¹ The support for additional activities such as the scrapping of old buses prevents transferring these costs to the passengers, a critical aspect in a very elastic market, where any small change to the fares turns a number of passengers away from public transit. Low-income passengers are particularly vulnerable, since they risk turning to more polluting and dangerous modes of transport: motorcycles and old used private cars.</p>	<p>Development impacts and other co-benefit are equivalent to those of the original CTF IP. However, as a result of the analysis done for the new National Development Plan 2010 -2014, additional benefits related with urban transformation and employment generation, as well as "Eco driving" were identified.</p>

²⁰ Reduction of 2.5 tPM/million pax; 18.1 tNO_x/million pax; and 0.3 tSO₂/million pax. (Grutter Consulting, 2006).

²¹ See Chaparro, I., 2002. *Evaluación del impacto socioeconómico del transporte urbano en la ciudad de Bogotá. El caso del sistema de transporte masivo Transmilenio*. ECLAC. tiny.cc/LCL1786

<p><i>CTF Additionality</i></p>	<p>The proposed CTF co-financing package is aimed at accelerating the adoption of sustainable, low-carbon investments in the sector in order to maximize modal shift towards public and non-motorized transport. The proposed investments are outside the scope of existing budgeted costs for the SITP and SETPs programs. At the same time, costs associated with scrapping programs and with the introduction of low-carbon bus technologies in the systems cannot be fully transferred to transit fares without adversely reducing the affordability of the transport system, particularly for the poor, making public transit far less attractive. Blending CTF resources with IDB and IBRD loans and other financing sources would make available investment capital in infrastructure, which may otherwise not be readily available for facilitating the integration of low-carbon technologies within the roll-out of the SITP and SETPs in cities nationwide. Thus, CTF financing would be instrumental in fostering the introduction of low-carbon bus technologies, scrapping programs, and related measures for optimizing and promoting an integrated land-use and transport system. The recent tender by the city Government for Bogotá's SITP indicates that low-carbon measures are currently not a priority due to the high costs of such investments</p>	<p>Equivalent to original CTF IP</p>
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Table 10. Assessment of Proposed Changes, Energy Efficiency

<p>CTF Investment Criteria</p>	<p>Original CTF IP (March 2010)</p>	<p>Revised CTF IP (April 2013)</p>
<p><i>Potential for GHG Emissions Savings</i></p>	<p>Based on data from the Uniandes study, and information by UPME, a cumulative emission reduction of 32 Mt CO₂e could be achieved with an investment of US\$ 670M, including US\$50M from CTF.</p>	<p>Based on the mentioned recalculation exercise the expected cumulative emission would be 4.9 Mt CO₂e and it is planned to achieve this target with US\$147.2 million.</p>
<p><i>Replication and scalability potential.</i></p>	<p>In the commercial and industrial sectors, energy efficiency investments could be scaled up through mobilizing existing local financial resources, through the provision of appropriate capacity building in the Colombian financial sector and market, and through innovative risk mitigation instruments. The existence of large conglomerate economic groups in Colombia's private sector also facilitates replication or, more importantly, adoption of efficiency investments across many sectors simultaneously. In the residential sector, replication and scaling up would be achieved by leveraging carbon finance and private sector participation in conjunction with the government's coordination strategy and policy measures. Different delivery alternatives would be considered during the design phase of the program to ensure a successful implementation and market uptake/transformation of these particular sub-sectors. The Colombian financial market shows a high liquidity and interest in financing energy efficient investment and developing energy efficiency product lines, with the appropriate assistance.</p>	<p>No changes are considered</p>
<p><i>Cost- effectiveness</i></p>	<p>Program results indicators are as follows: Cost effectiveness of reductions is estimated at US\$21.0/ton for the entire financing, or about US\$1.6 of CTF resources/ton.</p>	<p>Cost-effectiveness of expected reductions is estimated at US\$30.04/ t CO₂e for the entire financing, or about US\$7.96 of CTF resources/t CO₂e.</p>

<i>Environmental co-benefits</i>	Energy efficiency reduces energy demand, avoiding burning of fossil fuels for thermal uses and power generation and postponing the building of new fossil fuel power plants and other energy sector infrastructure. This has a range of global and local air quality benefits. Air pollution from the energy sector includes not only GHG emissions, but also SO ₂ , NO _X , Hg, and PM emissions.	No changes considered.
<i>Development Impact</i>	The energy efficiency investments in the residential sector, such as appliance replacements, would be addressed particularly in low-income dwellings, yielding therefore a positive distributive impact. Reductions in customer utility bills could also be expected with the introduction of higher-efficiency appliances and lighting. The Colombian government will experience fiscal benefits from reduced government subsidies to low-income residential customers, as well as a more competitive economy. National benefits also include increased energy security, lower exposure to fuel price volatility risks, and deferred investments in generation capacity and other energy infrastructure.	No changes considered.

Finally, the proposed changes include additional potential impacts of the revised CTF/IP objectives, related with the non-conventional renewable energy program as follows (see Annex 1 before):

Table 11. Assessment of Proposed Changes, Non-Conventional Renewable Energy

CTF Investment Criteria	Revised CTF IP (April 2013)
<i>Potential for GHG Emissions Savings</i>	Based on available data and calculations of the Ministry of Mining and Energy of Colombia, the GHG Emissions Savings of the Program amount to 19,221tCO ₂ e/year.
<i>Transformative potential</i>	With the proposed project “Promotion of Privately Operated, Medium Scale Commercial Non-Conventional Renewable Energy (NCRE) Power Generation Plant”, CTF funds blended with other sources will finance one project of 20MW carried out by private investors. This new installation will improve awareness by the market on the specificities of a renewable energy project and provide information for further additional investments. Such deployment will also dispel concerns about the stability of the grid and allow the adoption of a number of measures and initiatives to accelerate the rate of technology change in the sector. It is expected that in the future, a new regulatory framework will accept entirely NCREs technology in a multiple sources energy matrix framework that can comply with reliability principles and low carbon strategies.
<i>Replication and scalability potential.</i>	It is expected, that if Colombia effectively overcomes the existing barriers, a possible scenario, under the assumptions of the Background Report on the Energy Sector, prepared for the ongoing Colombia Low-Carbon Development Study”, DNP and the World Bank, Dec 2012, could result in potential reduction of additional 7.74 Mt CO ₂ e.
<i>Cost-effectiveness(CTF US\$/tCO₂e reduction over 20 years)</i>	Cost-effectiveness of reduction is 26 US\$/tCO ₂ e reduction over 20 years (20MW wind power). With the additional 413MW, in other words (20MW + 413MW of wind powered thermal plants) the reductions is 1.23 US\$/tCO ₂ e over 20 years.
<i>Development impacts</i>	Among the specific benefits that low-carbon activities can have are improving competitiveness, contributing to the growth of the economy, promoting sustainable development and increasing resilience, and advancing social development goals.
<i>CTF - Additionally</i>	There is a mature entrepreneurial sector and market players are well acquainted of energy market functioning. The financial stimulus of CTF funds will incentivize private investors by facilitating the covering of incremental costs associated with renewable energy generation

Risks

The Overall Risk after Mitigation for the proposed CTF Plan is considered **moderate** for the sustainable urban transport program, **low** for the efficiency energy program and remains unchanged from the original plan and **moderate** for the non-conventional renewable energy program. The main risks are identified and mitigation measures discussed for each of these two sectors in the following tables.

Urban Transport Risk assessment. As presented in the original CTF IP, overall risk for the transport investment is moderate based on the fact that institutional, regulatory and policy requirements are in place, while the technologies and systems to be deployed have shown that they can be successfully implemented in Colombia's SITM and will be tested in the country and other cities. In the case of low-carbon technologies, such as hybrid or CNG buses, a pilot activity is being supported by the IDB. However, the implementation capacity for Bogotá's SITP poses greater risks as the program is quite ambitious and requires coordination with other modes of transport and operators. Table 12 summarizes the main risks and risk mitigation measures associated with this investment.

Table 12. Risk matrix, Sustainable Urban Transport²²

Risk	Mitigation	Residual risk
<i>Policy and regulatory framework</i>	<p>The PNTU define cities participating in the SITM and SETP programs, and the subsidiary agreements lay out the financial and technical specifications for the design and implementation of these programs.</p> <p>The IDB is supporting the development of an integrated land-use and transport planning strategy for the city of Bogotá, including the reformulation of the regulation that establishes the financial and management land-based instruments for the city (<i>Plan de Ordenamiento Territorial – POT</i>). Some of these instruments include land value capture mechanisms to finance transit infrastructure in the SITP projects, and complementary land-use and zoning regulations that are required to induce transit-oriented development.</p>	L

²² As possible one or two new large cities are not still selected by Ministry of Transport this risks are not evaluated and consequently not presented in the table.

Risk	Mitigation	Residual risk
<p><i>Implementation capacity:</i> Limited institutional capacity to implement SETPs Integration with other modes in the Bogotá's SITP is not effectively achieved Unknown one or two additional selected cities to develop SITP projects</p>	<p>In the model adopted for the implementation of SITMs, the GoC: (i) created an incentive for the cities to implement the program by securing future budget support and eliminated the risk of a potential change in Government or municipal policy; (ii) transferred program implementation to local authorities, promoting local ownership and knowledge creation, and (iii) provided an incentive for local governments to focus on sound and longer-term policy and related investments. As mentioned above, the IBRD through its technical assistance component has supported capacity building activities in the SITMs to strengthen local BRT Agencies implementation capacity, and the overall role of other local stakeholders (Transit Secretariats, Metropolitan Authorities, etc). The main characteristics of this model will remain relevant for the implementation of SETPs, adjusted based on the lessons learnt from the SITMs.</p> <p>For the SETPs, the IDB will review the demand estimates, business models and financial results, and agree on an Implementation Program in order to assure that technical capacity and financial resources are available and consistent with an optimized work schedule.</p> <p>The technical cooperation loan that the IDB is executing to support the design and implementation of the SITP will help strengthen local capacities to manage the whole integration of the transit system with other transit modes and in coordination with air quality, urban development and transport sector plans.</p> <p>The Ministry of Transport will take into account readiness for implementation in the new selected one or two cities, and reinforced assistance in prep grant through IBRD will support the design and implementation of SITP project as well as strengthening of local capacities to manage the whole integration of transport modes into the SITPs.</p>	H
<p><i>Technology:</i> Financial analysis shows that it is not feasible for cities to integrate low-carbon technologies given investment, operation and maintenance costs, and tariff structures, among other factors. New bus technology presents operational and maintenance problems</p>	<p>While there are no elements in the current institutional, legal and regulatory framework ensuring low-carbon (e.g. hybrid) technologies would be introduced in the foreseeable future, the SITP and SETPs will have a window of opportunity to allow for their gradual introduction over time as their use becomes more ubiquitous.</p> <p>Although the hybrid bus technology is not new, a Test Program (CCI-IDB) will be conducted in Bogotá, and other regional cities. The expected benefits of the program are: (i) reduction in upfront testing costs for the cities participating in the initial bus tests and for the cities seeking to purchase hybrid buses based on the results of initial bus tests; (ii) long-term market benefits for the acceleration of the energy efficient transport industry in the region, lowering costs; (iii) development of new production lines, specialized services, and markets in Latin America, and (iv) identification of strategic actions to (1) remove possible legal and economic barriers for this technology in Latin America and (2) help multilateral, national and local institutions to use market mechanisms to reduce GHG emissions by transforming the urban transport sector.</p>	M
<p><i>Finance:</i> Lack of local (municipal) financial resources to implement the SETP programs, the Bogotá's SITP and the future selected (one or two) SITP projects</p>	<p>Cities participating in the SITM and SETP programs sign subsidiary agreements with the GoC laying out financial commitments. GoC funding is committed through a flow of earmarked yearly fiscal transfers (<i>vigencias futuras</i>).</p> <p>SETP and Bogotá's SITP will receive multilateral loan resources and will be complemented with carbon finance and other grant resources, thereby reducing risk. An adjustment in implementation schedule will reflect available resources including commitments from participating cities.</p>	L - M

Risk	Mitigation	Residual risk
<p><i>Environmental and social safeguards:</i> While addressing GHG emissions, local airborne pollutants and air quality concerns may be ignored Stakeholder opposition in view of the varied and complex issues involved in implementing changes of the SITP and SETPs</p>	<p>Project design will follow GoC, local and multi-lateral bank safeguards. Appropriate environmental management measures will be incorporated into project design. The options to be supported will render both global and local benefits and promote improvements in air quality, while reducing emission of GHG and air toxics. The PNTU addresses these global environmental objectives. This strategy will be also reinforced through the IDB technical cooperation to develop an integrated environmental strategy (IES) for a sustainable urban mobility in Bogotá, which could then be replicated in other Colombian cities. Stakeholder support will be enhanced through project design components and IDB technical cooperation to provide advisory support and training to the incumbent bus transit operators for the transition and industry transformation that will be required for the new SITP and SETPs.</p>	M
<p><i>Development potential:</i> Operators and other stakeholders oppose the implementation of the systems The experience in the SITM is not used as a basis for replication in other cities</p>	<p>A comprehensive consultation process will take place to ensure commitment and ownership by all involved. Dissemination and training actions are being taken to ensure that lessons from Colombia are considered in the development of similar activities in the entire region. Lessons from MDB-financed projects throughout Latin America and the Caribbean (LAC) will be used for training to ensure that lessons learned are considered in the development of similar activities in the entire region.</p>	M
<i>Procurement</i>	This has not been an issue in the SITM program. The IBRD and IDB loans will provide further support where necessary.	L
<i>Overall</i>		<i>Moderate</i>

Energy Efficiency Risk assessment. Table 13 summarizes the main risks and risk mitigation measures associated with the energy efficiency investments.

Table 13. Risk matrix, Energy Efficiency

Risk	Mitigation	Residual risk
<p><i>Implementation capacity:</i> Limited institutional capacity to coordinate the implementation of the proposed activities in the public sector Limited implementation capacity by financial institutions</p>	<p>Technical, organizational and financial assistance to strengthen the relevant agencies will be provided. A significant part of the CTF Efficiency Program is focused on mechanisms to foster financial institution and technical expert capacity building. Once a base of technical expertise is developed within Colombia to provide training for financial institutions capacity building can be provided to similar institutions on an ongoing basis in a sustainable manner without CTF support.</p>	L
<p><i>Knowledge barriers:</i> Limited demand for efficiency investments due to knowledge and technical expertise barriers</p>	<p>As noted above the CTF Efficiency Program will provide technical assistance to companies and include activities aimed at disseminating knowledge among all relevant stakeholders. It will also include programs aimed at strengthening the technical expertise base in Colombia. It is expected that once there are sufficient examples of the cost benefits of technology adoption with key companies within a sector, competitive forces will step in to drive demand, both for knowledge (companies will begin to seek audits) and investment.</p>	M
<p><i>Regulatory:</i> Distribution companies do not have an incentive to encourage end users to invest in energy efficiency</p>	<p>As mentioned, the government will begin evaluating new mechanisms for aligning the incentives of distribution companies to pursue energy efficiency investments for the 2013 regulatory cycle. In the short term, programs such as EPM's offer potential for scale-up in the residential sector, even in the absence of a regulatory change. The industrial and commercial sectors do not rely on distribution companies to facilitate energy efficiency investments, and instead are driven by market forces to pursue such investments.</p>	L

Risk	Mitigation	Residual risk
<i>Market uptake:</i> Market uptake does not occur at the expected rate	This is likely the most significant risk in the program and can occur for many reasons, including lack of management attention within the financial institutions and/or the end user companies. To mitigate this, the CTF Efficiency Program will seek to work only with financial institutions that have fully “bought in” to the process and are willing to dedicate the time necessary, at the senior level, to influence institutional uptake at the operational level. On the end user side, the MDBs will focus energy efficiency audits on companies that have both influence in the market (can ignite competition), have management buy in, and are willing to share information on their experiences.	M
<i>Technology risks:</i> New more efficient technologies present operational and maintenance problems	Only well proven technology would be supported.	L
<i>Overall</i>		<i>Low</i>

Non-Conventional Renewable Energy Risk assessment. Table 15 summarizes the main risks and risk mitigation measures associated with the energy efficiency investments

Table 15. Risk matrix, Non-Conventional Renewable Energy

Risk	Mitigation	Residual risk
<i>Policy and regulatory framework:</i> Non-conventional renewable energy sources inside the SIN are not allowed at an additional scale.	Government has given priority to the promotion of RE through its PND 2010-2014 and has proposed a sectoral reform that regards attentively the topic.	L
<i>Environmental and social safeguards</i>	IBRD/IFC/EBRD safeguard policies will apply to all interventions. Additionally Colombian Legislation applies strict environmental and community consultation rules to all projects.	L
<i>Development potential</i>	The program will provide for mechanisms to assure that the relevant information and lessons learned from the project are disseminated among different stakeholders interested in further development of renewable energy	M
<i>Knowledge barriers:</i> Limited demonstrative capacity to overcome knowledge barriers	As noted above the CTF NCREs Program will provide information and experience to overcome knowledge barriers. The Program and the new policy and regulatory environment won't be enough to start further regulatory changes and strong investments in NRECs technologies.	M
<i>Overall</i>		<i>Medium</i>

MONITORING AND EVALUATION

Table below presents the summary of the revised expected Results Indicators and their target values. For each project, monitoring and evaluation will be carried out by the implementing agency (described below) as part of the monitoring process for the entire project, including co-financing and other contributions.

Table16. Summary of Revised Expected Result Indicators

Summary Result Indicators	Target Value (Original CTF IP)	Target Value (Revised CTF IP)
Co-financing of CTF funding (US\$ million)	150	150
Leveraged co-financing (\$US million)	2.879,8	1.103,3
GHG emissions savings (Mt/CO ₂ e)/year)	77	36,42
CTF Cost Effectiveness (CTF US\$/tCO ₂ e reduction over 20 years)	1.95	4,1

The GoC has assigned the National Planning Department (DNP) to coordinate the implementation of the CTF Plan and facilitate the exchange of information among the ministries responsible for project preparation and implementation. The nominated Agency will consolidate result indicators into the CTF results framework, measuring the output, outcome and impact of the projects using the indicators specified in the above table.

ANNEX 1: CONCEPT NOTE FOR THE NON-CONVENTIONAL RENEWABLE ENERGY PROGRAM

Problem Statement

The energy regulatory framework in Colombia promotes competition and tools have been designed to attract expansions based on their cost-effectiveness and assured ability to dispatch energy in every moment. Environmental costs from GHG emissions are not internalized. Concerns about the stability of the network and the capacity to deal with intermittency of some NCRE in the National Interconnected System (SIN) have been raised in face of the possibility of a bigger participation of such technologies in the energy matrix. Consequently, the regulatory framework is not likely to promote NCRE resources, but rather maintain a high capacity share of hydropower complemented with a more carbon-intensive energy resource mix (likely reliant on abundant coal reserves and gas). This situation would result in an increase in the carbon footprint of the power matrix from its current, relatively low-level of GHG emissions. In addition, a largely hydro-based power system may be susceptible to anticipated climate variability affecting rainfall patterns. A projected increase in the intensification of the water cycle and the possible intensification of extreme events (El Niño-Southern Oscillation [ENSO] and La Niña) associated with temperature dipoles on the Pacific coast of Colombia may raise the vulnerability of the power sector by affecting the reservoir capacity of hydropower-based plants.²³ Early evidence of impacts of extreme events in the hydrology of major basins in Colombia is already documented by IDEAM.²⁴

Proposed Transformation

With the proposed project “**Promotion of Privately Operated, Medium Scale Commercial Non-Conventional Renewable Energy (NCRE) Power Generation Plant**”, CTF funds blended with other sources will finance one NCRE project of approximately 20MW carried out by private investors. This new installation will improve awareness by the market on the specificities of a renewable energy project, provide information for further additional investments and allow the adoption of a number of measures and initiatives to accelerate the rate of technology change in the sector. The NCRE type selected for this program may or may not be an intermittent one, but if so, such deployment will also dispel concerns about the stability of the grid.

Implementation Readiness

There is a mature entrepreneurial sector and market players are well acquainted of energy market functioning. The financial stimulus of CTF funds will incentivize private investor by facilitating the covering of incremental cost associated with renewable energy generation. In such environment, this incentive can rapidly catalyze the market conditions to attract more investment towards NCRE technology and reduce its costs.

Rationale for CTF Financing

CTF funds blended with other sources, will contribute to investments that will provide information and the experience required to catalyze a larger adoption of a particular NCRE technology. It will also help to

²³ Vergara, Deeb, Toba, Cramton and Leino, 2010. *Wind Energy in Colombia: A Framework for Market Entry*. World Bank. <http://bit.ly/WB55842>

²⁴ IDEAM Informe Annual, 2011. Bogota.

overcome the information barriers that prevent a larger presence in the market of NCRE and will allow the country to keep its power matrix in a relatively low-level of GHG emissions.

Results Framework, Financing Plan, Timetable

Table 17. Results Framework, Non-Conventional Renewable Energy

Results Indicator	Target Value Revised CTF IP (April 2013)
Co-financing of CTF funding (US\$ million)	10
GHG Emissions Savings (tCO ₂ e/year)	19,221
RE Installed Capacity (MW)	20
CTF Cost Effectiveness (CTF US\$/tCO ₂ e reduction over 20 years)	26

Table 148. Financing Plan, Non-Conventional Renewable Energy

Financing Source	Amount (US\$ million)
CTF	10
IDB	10
Private Sector (Sponsors and commercial banks)	24
Total	44

Table 159. Project Preparation Timetable, Non-Conventional Renewable Energy

Milestone	Date
TFC Approval	Q4-2013
Board Approval	Q1-2015
Effectiveness Date	Q2-2015
1st Disbursement	Q3-2015

In summary, some of the advantages of a NCRE power plant in Colombia include:

For Wind generation:

- Diversification of energy generation, since it would incorporate a new technology and a new resource in electricity generation capacity;
- Complimentarily with hydroelectric generation at critical times of water supply in the case of wind energy alternative ;
- Release of non-renewable domestic energy resources (natural gas, coal and oil) for international markets;
- Potential for domestic technology development, and
- Evolution and development of regulatory and market schemes to promote new electricity generating technologies.

For geothermal generation:

- Diversification of energy generation with a resource that is considered to be renewable, highly firm, and independent of climatic variables;
- Low operating and overall costs (with levelized costs less than coal);
- High capacity factors (above 90 percent);
- The waste produced is minimal and have a smaller environmental impact than those stemming from thermal plants that use coal or natural gas.