Technical Cooperation Document

I. Basic Information for TC

▪ Country/Region:	REGIONAL
▪ TC Name:	Empirical Analysis of Air Pollution and Climate Change Mitigation Actions in LAC
▪ TC Number:	RG-T2761
▪ Team Leader/Members:	HOFFMANN, BRIDGET LYNN (RES/RES)-Co-team Leader; RIOS GALVEZ, ANA R. (CSD/CCS)-Co-team Leader; MILLER ASTETE, SEBASTIAN JOSE (CSC/CCH)-Team Member; GUANNAIS DE AGUIAR, FREDERICO CAMPOS (SPH/CPE)-Team Member; HOFMANN, MICHAEL (MIF/MIF)-Team Member; MELENDEZ APARICIO, SOFIA TERESA (RES/RES)- Project Assistant BAZA, ESCARLATA (LEG/SGO)-Team Member and Assigned Lawyer
▪ Indicate if: Operational Support, Client Support, or Research & Dissemination	Research and Dissemination
▪ If Operational Support TC, give number and name of Operation Supported by the TC:	Not Applicable
▪ Date of TC Abstract authorization:	9 May 2016
▪ Beneficiary (countries or entities which are the recipient of the technical assistance):	Policymakers in LAC, in particular Mexico and Chile
▪ Executing Agency and contact name (Organization or entity responsible for executing the TC Program) {If Bank: Contracting entity} {If the same as Beneficiary, please indicate}	Inter-American Development Bank
▪ Donors providing funding:	Sustainable Energy and Climate Change IDB Special Program (SCI)[1]
▪ IDB Funding Requested:	$450,000
▪ Local counterpart funding, if any:	$112,500
▪ Disbursement period (which includes Execution period):	36 months
▪ Required start date:	August 2016
▪ Types of consultants (firm or individual consultants):	Individuals and Firms
▪ Prepared by Unit:	Research and Chief Economist Department
▪ Unit of Disbursement Responsibility:	RESEARCH DEPARTMENT
▪ TC Included in Country Strategy (y/n):	Yes
▪ TC included in CPD (y/n):	No

[1] The focus of this technical cooperation is aligned with the SECCI as one of the purposes of this fund is to finance activities aimed at mainstreaming climate change into policies and programs across the region (see GN-2435-6).

▪ GCI-9 Sector Priority:	Addressing climate change, renewable energy, environmental sustainability and food security

II. Objectives and Justification of the TC

2.1 The main objective of this TC is to assist decision makers in the design of climate change mitigation and air pollution policies and programs by providing information regarding: (i) the effect of distributing salient and readily-assessable air pollution, and (ii) the valuation of health co-benefits of climate change mitigation actions.

2.2 Air pollution and climate change are closely related: air pollutants such as ozone and particle pollution –i.e. black carbon− contribute to global warming and similarly climate change could have negative impacts on national air quality (EPA, nd). Climate change mitigation actions could hence contribute to improving air quality and a decrease in ozone and/or black carbon emissions could help in reducing climate change impacts in the near-term as these particles stay in the atmosphere for a few days or weeks.

2.3 Climate change and air pollution are also associated with negative health impacts. High air pollution has been causally linked to infant mortality in Mexico, lost income for poor households in Mexico, infant mortality and pre-mature mortality in Chile, and lower educational outcomes in Chile (Arceo, Hanna, and Oliva, 2016; Hanna and Oliva, 2014; Miller and Ruiz-Tagle, 2015; Miller and Vela, 2013). In Latin America and the Caribbean (LAC), more than 50 percent of the population from developing countries is exposed to air pollution above the levels recommended by the World Health Organization (WHO).[2] Specifically, in 2013, 59% of the population of Chile and 62% of the population of Mexico were exposed to air pollution above WHO recommended levels. Providing households with salient air pollution information will therefore allow them to make informed decisions regarding their avoidance and prevention behavior. For instance, the United States −among other governments− issues smog alerts, and people adjust their short-term behavior in response to these alerts (Zivin and Neidell, 2009).

2.4 On the other hand, some climate change mitigation actions provide –besides direct climate benefits− health co-benefits including a reduction of respiratory and cardiovascular illnesses and their associated costs in terms of treatment and labor productivity loss (Vergara et al., 2013; Younger et al., 2008). These co-benefits are often excluded from the economic analysis of projects due to difficulties in data availability (for more details see Climate Change Sector Framework).

2.5 This technical cooperation focuses on climate vulnerability, climate and environmental risk, and actions to manage, adapt, and mitigate the impacts of climate change and pollution. This TC is aligned with the “Institutional Strategy 2010-2020”, in which climate change is an overarching issue that affects the three main development challenges in LAC. This TC is framed within the “Integrated Strategy for Climate Change Adaptation and Mitigation, and Sustainable and Renewable Energy” (GN-2609-1) and the “Climate Change Sector Framework” (OP-2018). In addition, this TC is aligned with the country strategies of Mexico and Chile.[3]

[2] http://data.worldbank.org/indicator/EN.ATM.PM25.MC.ZS/countries/MX-XJ-CL?display=graph

[3] Page 19 of the country strategy for Mexico states that “The Government of Mexico will therefore aim to strengthen national climate change policy and minimize the vulnerability of urban and rural areas of the

2.6 The results from this TC will guide the design of operations aimed as assisting countries to achieve their climate pledges, specifically policy reforms and investments that target the mitigation goal established in their Intended Nationally Determined Contribution (INDC)[4]. Moreover, the analysis conducted under this TC will contribute to a better understanding of the value of co-benefits of mitigation of air pollution and improved health, which tend to be excluded from the economic analysis due to the lack of data. By collecting and analyzing this information, internal and external decision makers will be able to make sounder decisions based on a comprehensive evaluation of these interventions.

III. Description of activities/components and budget

3.1 Component 1: Implementation of programs. This component will finance two interventions, one in Mexico and one in Chile. The interventions will be implemented as randomized controlled trials, which are considered the gold standard in experimental methods. Randomized controlled trials eliminate biases, such as selection bias, from the evaluation of the intervention.[5] Both interventions will include comprehensive household surveys to collect the data necessary for the evaluation of the programs.

3.2 The intervention in urban areas of the Federal District and/or the State of Mexico will provide households with real-time outdoor air pollution (mostly caused by the transportation sector) information through an SMS (Short Messaging System) messaging system.[6] Without easily assessable, real-time information on air pollution, households are not able to make informed decisions regarding pollution avoidance behavior, such as staying inside during high pollution times, closing windows, covering mouth and/or nose in traffic.

3.3 A preliminary survey of 440 households in Mexico City and Toluca conducted in 2014 found that over 70% of surveyed households considered air pollution an important or very important problem and about 60% of surveyed households had engaged in some form of pollution avoidance behavior. However, only 5% of surveyed households had ever visited the government webpage that provides information on air pollution, and a fifth of respondents had never heard of the government's air quality index known as IMECA. Further, 63% of respondents did

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effects of climate change". Page 9 of the country strategy for Chile states that "The Bank, in turn, can facilitate the development and execution of energy projects in a crosscutting manner, by (i) contributing to the strengthening of the Ministry of Energy and to dialogue within a participatory planning process to set an energy policy; (ii) providing support in issues of land-use planning (including indigenous community territories), facilitating development of energy projects and decisions regarding the most suitable location for them; and (iii) providing support on climate change issues".

[4] Mexico and Chile have submitted their INDCs to the United Nations Framework Convention on Climate Change (UNFCCC), which highlight key actions to be taken on mitigation and adaptation towards 2030. For detailed information see http://www4.unfccc.int/submissions/INDC/Published%20Documents/Mexico/1/MEXICO%20INDC%2003.30.2015.pdf for Mexico and http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Chile/1/INDC%20Chile%20english%20version.pdf for Chile.

[5] In this case, without randomization, we would be concerned that our results are biased by the fact that households who select into receiving air pollution information or specific types of air pollution information may be more likely to change their behavior in response to the information.

[6] The intervention will take place in Mexico City, and may also include households in Toluca, in order to build on the preliminary survey conducted in 2014.

not venture to answer how many days in the previous six months had air pollution above standards. The simple SMS text messages provided as part of the intervention will allow households without smart phones or internet access to easily access and understand real-time air pollution information, but the sample will be restricted to households in which at least one household member owns a phone with SMS capabilities. The air pollution information used in the SMS messages will be data collected by the Instituto Nacional de Ecología y Cambio Climático.

3.4 Data on demographics, health characteristics, and baseline engagement in pollution avoidance behaviors will be collected in a baseline survey. After the baseline survey, a willingness to pay experiment will be conducted.[7] Households will be randomly assigned to various price treatment groups for the SMS messages. Finally, follow-up surveys will be conducted to measure avoidance behaviors at the household level, such as staying inside on high pollution days, closing windows, or covering mouth and/or nose in traffic, after the provision of air pollution information through the SMS messages. Health effects will be measured primarily through survey questions. Household data will be collected over a period of approximately one year.

3.5 The intervention in Valdivia will provide households with household-level information on the level of air pollution and information on household emissions driven by the use of wood burning stoves. In using wood burning stoves, households face a tradeoff between fuel costs and the creation of emissions. Using certified firewood and/or opening the chimney increases fuel costs but also lowers air pollution emissions.

3.6 Air pollution from burning wood fuel for heating and cooking is a serious problem for cities in the central-south region of Chile, including Valdivia (MMA, 2013). Valdivia has experienced pollution levels above national standards for three consecutive years. As a result, Valdivia was declared saturated of particulate matter and a Plan to Reduce Air Pollution (Plan de Descontaminación Ambiental, PDA) is being developed by Chile's Environmental Ministry. However, current policies have not had an impact on reducing emissions and previous studies have shown that this is mainly because these policies are not considering users' behavior. Furthermore, there is only one air-quality monitoring station in the city of Valdivia so accurate measurements at the household or neighborhood level are not available.

3.7 Objective, real-time measures of household level emissions (for example, air pollution measures using AirBeams or stove air-inlet measures) will be recorded before and after the information intervention in order to measure decreases in household emissions. The household survey will also collect data on household behaviors related to air pollution emissions, such as quantity and type of firewood used, number of hours of stove use, and number of times the stove is charged with firewood.[8]

3.8 Component 2: Analysis of the programs. This component will support the writing of two working papers that include an empirical evaluation of the interventions implemented. The working papers will be submitted to the IDB paper series. It will also support the writing of a technical note that discusses and summarizes the quantitative and qualitative findings of both the intervention in Mexico and the intervention in Chile.

[7] Approximately 1,500 households will be included in the willingness to pay experiment.
[8] Approximately 200 households will be included in the experiment in Valdivia with approximately equal-sized treatment and control groups.

3.9 Together the information collected and analyzed from these two randomized controlled trials will contribute to the decision-making process on several dimensions. First, we will be able to determine whether an SMS information program is self-sustainable from a cost perspective. Second, we will be able to determine whether air pollution information programs reduce households' exposure to air pollution, and therefore, reduce the health and economic costs of air pollution to households. Third, we will be able to shed light on the optimal type of information to provide in order to induce changes in household behavior. Fourth, by estimating the change in air pollution exposure and its associated health costs, a proxy for climate change health co-benefits will be available.

3.10 Component 3: Dissemination of results. This component will finance the dissemination of results from the interventions. Activities include: i) meetings with government agencies to present the results of the interventions, to discuss any potential improvements recommended before adoption of similar policies, and to summarize lessons learned that will be important for scale up; and ii) seminars to present the results of the analysis to government agencies, academics, and other interested stakeholders.

Indicative Results Matrix

Expected Results/Outputs	Unit of Measure	Baseline	End of Project Goal	Means of Verification	Expected Completion Date
Result: the project contributes to a better understanding and valuation of the co-benefits associated with climate change mitigation actions					
Component 1/Outputs					
Approved household surveys designed and formatted	Number of household surveys	0	2	Received and approved by team leader	August 2017
Delivered and approved household level datasets collected through household surveys	Number of household-level datasets	0	2	Received and approved by team leader	January 2019
Component 2/Outputs					
Working papers published as part of the IDB working paper series	Number of IDB working papers	0	2	IDB working paper series	June, 2019
Technical notes summarizing the results of both experiments and discussing policy implications published internally	Number of IDB technical notes	0	1	IDB publications	June, 2019
Component 3/Outputs					

Seminars and meetings with government officials and policy makers	Number of meetings and seminars	0	2	Meeting agendas	June, 2019

3.11 The total amount of funding need to achieve the expected outputs and the in-kind local counterpart financing provided by Instituto Nacional de Ecología y Cambio Climático of Mexico (INECC) is shown in the table below. US$450,000 will be financed with resources from the Sustainable Energy and Climate Change IDB Special Program (SCI).

Indicative Budget (US$)

Activity/Component	Description	IDB/Fund Funding	Counterpart Funding[9]	Total Funding
Component 1: Implementation of programs through RCTs[10]	• Development of SMS system and transmitting information to households • Development of household survey and primary data collection) in Mexico • Development of household survey and primary data collection in Chile	• 25,000 • 327,500 • 67,500	102,500	522,500
Component 2: Analysis of the programs and writing papers and technical note	• Working papers (2) • Technical note	20,000	0	20,000
Component 3: Dissemination of results	• Seminars and meetings with government officials and policymakers	10,000	10,000	20,000
Total		**450,000**	**112,500**	**562,500**

3.12 This project will use data from INECC's National System on Air Quality that is publicly available online. In addition, INECC will assist in arranging and coordinating meetings, seminars, and/or workshops with government officials and policymakers to disseminate the results and has committed to attending these events. As a team leader for this TC, Bridget Hoffmann (RES/RES) will work in close coordination with

[9] Local in-kind counterpart funding will be provided by the Instituto Nacional de Ecología y Cambio Climático (INECC) in Mexico. In component 1, INECC will contribute processing data from the National System on Air Quality. INECC will also contribute logistics support and provide feedback on the questionnaire and survey design. In component 3, INECC will assist in organizing working groups with local authorities, organizing meetings with other government agencies to disseminate results. In addition, INECC commits to attend workshops to discuss findings.

[10] Of the total amount 420,000, approximately 353,500 will be used for the experiment in Mexico and approximately 67,500 will be used for the experiment in Chile.

the firms and consultants working in the field. Sebastian Miller (CSC/CCH) will be available for advice regarding the activities in Chile. Neither the Mexican nor the Chilean country office will need to be involved in the supervision of this TC.

IV. Executing agency and execution structure

4.1 The Bank through RES/RES will execute this technical cooperation, with the technical advice of the Climate Change specialists. This is justified given the regional scope of planned activities, outputs, and outcomes and the Bank's experience-particularly that of the Research Department (RES)-in generating knowledge for the benefit of LAC countries. The IDB, as executing agency, will be able to coordinate activities among projects and create synergies, as well as facilitate the dialogue and discussion between key actors.

4.2 The team leaders will directly monitor the submission of deliverables and track that these products are delivered according to the planned timeline for the project.

4.3 The Bank will contract individual consultants, consulting firms and non-consulting services in accordance with current Bank procurement policies and procedures (AM-650 for individual consultants and GN-2303-20 for consulting firms and non-consulting services).

4.4 The Bank hasobtained a letter of non-objection from Chile and will obtain a letter of non-objection from Mexico prior to the initiation of activities in Mexico. The project in Mexico has a letter of support from the Instituto Nacional de Ecología y Cambio Climático in Mexico, which states that this research will assist local and federal authorities in understanding how information provision changes decisions by schools, families and individuals and will allow conclusions to be drawn regarding the co-benefits of low-carbon economy policies. The project in Chile has a letter of support from the Ministerio de Energía in Chile, which states that this research will inform the development of the Plan to Reduce Air Pollution (PDA) for Valdivia being developed by Chile's Environmental Ministry.

V. Major issues

5.1 The main risks in the successful and timely execution of the project are the availability and quality of information as well as qualified consultants that might be able to perform the data collection and analysis work required for the study. To address and minimize these risks, advances have been made in the identification of information sources and pool of candidates that might perform the required tasks. Moreover, local involvement and support have been secured. There is a possibility that households will not adjust their behavior as a result of the information provided as part of the experimental programs. However, the team does not consider this to be a significant risk (provided that the experiments have sufficient statistical power) as this outcome will still contribute important information and knowledge to public policy discussions regarding the implementation of similar programs.[11] In addition, we will complete an external IRB approval process for both projects and use informed consent when surveying households.

[11] Chile's Environmental Ministry is developing a Plan to Reduce Air Pollution (PDA) for Valdivia. This plan proposes public policies to be implemented in the next 15 years to reduce levels of air pollution. This research will determine whether a public policy similar the one studied will a useful addition to the PDA (see letter of support).

VI. Exceptions to Bank policy

6.1 This TC does not involve any exceptions to Bank policy.

VII. Environmental and Social Strategy

7.1 There are no environmental or social risks associated with the activities outlined in this TC, therefore the ESG classification for this operation is [C].

Annexes:

- Procurement Plan
- Terms of Reference – Consultancy Firm Chile
- Terms of Reference – Consultancy Firm Mexico
- Letter of Support INECC - Mexico
- Letter of Support Chile
- Non-objection letter Chile

EMPIRICAL ANALYSIS OF AIR POLLUTION AND CLIMATE CHANGE MITIGATION ACTIONS IN LAC

RG-T2761

CERTIFICATION

I hereby certify that this operation was approved for financing under the Sustainable Energy and Climate Change IDB Special Program **(SCI)** through a communication dated **May 9, 2016** and signed by Felipe Caicedo. Also, I certify that resources from said fund are available for up to **US$450,000** in order to finance the activities described and budgeted in this document. This certification reserves resource for the referenced project for a period of **four (4) calendar months** counted from the date of eligibility from the funding source. If the project is not approved by the IDB within that period, the reserve of resources will be cancelled, except in the case a new certification is granted. The commitment and disbursement of these resources shall be made only by the Bank in US dollars. The same currency shall be used to stipulate the remuneration and payments to consultants, except in the case of local consultants working in their own borrowing member country who shall have their remuneration defined and paid in the currency of such country. No resources of the Fund shall be made available to cover amounts greater than the amount certified herein above for the implementation of this operation. Amounts greater than the certified amount may arise from commitments on contracts denominated in a currency other than the Fund currency, resulting in currency exchange rate differences, i.e. represent a risk that will not be absorbed by the Fund.

Original Firmado — 8/10/2016

Sonia M. Rivera
Chief
Grants and Co-Financing Management Unit
ORP/GCM

Date

Approved: Original Firmado — 8/15/2016

Jose Juan Ruiz Gomez
General Manager & Chief Economist
Department of Research and Chief Economist
RES/RES

Date