This publication was produced for review by the United States Agency for International Development. It was prepared by the Colombia Clean Energy Program (Tetra Tech ES, prime contractor)
COLOMBIA CLEAN ENERGY PROGRAM

Final Report
January 2012 – March 2017

Prepared for:
Office of Environment
USAID/Colombia

Prepared by:
Tetra Tech ES, Inc.
USAID Colombia Clean Energy Program
1320 N. Courthouse Road
Arlington, VA 22201
www.ccep.co

USAID Contract Number Contract AID-514-C-12-00002

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<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANDI</td>
<td>National Industrialists Association (Asociacion Nacional de Empresarios de Colombia)</td>
</tr>
<tr>
<td>ANLA</td>
<td>National Environmental Licensing Agency (Autoridad Nacional de Licencias Ambientales)</td>
</tr>
<tr>
<td>ACOPI</td>
<td>Colombian Association of Small and Medium Enterprises (Asociación Colombiana de Pequeña y Mediana Industria)</td>
</tr>
<tr>
<td>BBG</td>
<td>Bogotá Botanical Garden</td>
</tr>
<tr>
<td>BIO-REDD</td>
<td>Reduced Emissions from Deforestation and Degradation (USAID Program)</td>
</tr>
<tr>
<td>CAEM</td>
<td>Environmental Business Corporation (Corporación Ambiental Empresarial)</td>
</tr>
<tr>
<td>Cancillería</td>
<td>Colombian Ministry of Foreign Affairs (Ministerio de Asuntos Exteriores)</td>
</tr>
<tr>
<td>CCB</td>
<td>Bogotá Chamber of Commerce (Camara de Comercio de Bogota)</td>
</tr>
<tr>
<td>CCEP</td>
<td>Colombia Clean Energy Program (USAID Program)</td>
</tr>
<tr>
<td>EELA</td>
<td>Energy Efficiency in Latin America</td>
</tr>
<tr>
<td>CEIR</td>
<td>Indigenous Rural Educational Center (Centro Educativo Indígena Rural)</td>
</tr>
<tr>
<td>CERI</td>
<td>Regional Indigenous Educational Center (Centro Educativo Regional Indígena)</td>
</tr>
<tr>
<td>COLCIENCIAS</td>
<td>Administrative Department for Science, Technology, and Innovation (Departamento Administrativo de Ciencia, Tecnología e Innovación)</td>
</tr>
<tr>
<td>CNPMLTA</td>
<td>National Cleaner Production Center (Centro Nacional de Produccion mas Limpia y Tecnologias Ambientales)</td>
</tr>
<tr>
<td>CO₂</td>
<td>Carbon Di-Oxide</td>
</tr>
<tr>
<td>COP</td>
<td>Chief of Party</td>
</tr>
<tr>
<td>COR</td>
<td>Contracting Officer Representative</td>
</tr>
<tr>
<td>CORPOCESAR</td>
<td>Regional Environmental Authority for the Department of Cesar</td>
</tr>
<tr>
<td>CORPOGUAJIRA</td>
<td>Regional Environmental Authority for the Department of La Guajira</td>
</tr>
<tr>
<td>CREG</td>
<td>Power and Gas Regulatory Commission (Comision de Regulacion de Energia y Gas)</td>
</tr>
<tr>
<td>CVC</td>
<td>Valle del Cauca Regional Environmental Authority (Corporación Autónoma Regional del Valle del Cauca)</td>
</tr>
<tr>
<td>DANE</td>
<td>National Administrative Statistics Department (Departamento Administrativo Nacional de Estadística)</td>
</tr>
<tr>
<td>DCOP</td>
<td>Deputy Chief of Party</td>
</tr>
<tr>
<td>DNP</td>
<td>National Planning Department (Departamento Nacional de Planeación)</td>
</tr>
<tr>
<td>DPS</td>
<td>National Prosperity Department (Departamento para la Prosperidad Social)</td>
</tr>
<tr>
<td>EC-LEDS</td>
<td>Enhancing Capacity for Low Emission Development Strategies</td>
</tr>
<tr>
<td>EE</td>
<td>Energy Efficiency</td>
</tr>
<tr>
<td>EMMP</td>
<td>Environmental Mitigation or Monitoring Plan</td>
</tr>
<tr>
<td>EPM</td>
<td>Empresas Públicas de Medellín</td>
</tr>
<tr>
<td>EPSA</td>
<td>Empresa de Energía del Pacífico S.A.</td>
</tr>
<tr>
<td>ESCO</td>
<td>Energy Services Company</td>
</tr>
<tr>
<td>FAZNI</td>
<td>Support Fund for the Non-Interconnected Zones (Fondo de Apoyo Financiero para la Energizacian de las Zonas No Interconectadas)</td>
</tr>
<tr>
<td>FCGI</td>
<td>Fundación Cerrejón Guajira Indígena</td>
</tr>
<tr>
<td>FDN</td>
<td>National Financial Development Corporation (Financiera de Desarrollo Nacional)</td>
</tr>
<tr>
<td>FINAGRO</td>
<td>Financial Fund for the Agriculture Sector (Fondo para el Financiamiento del Sector Agropecuario)</td>
</tr>
<tr>
<td>FINDETER</td>
<td>Financial Institution for Development (Financiera de Desarrollo Territorial)</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>FNCER</td>
<td>Nonconventional Renewable Energy Sources (Fuentes No Convencionales de Energía Renovable)</td>
</tr>
<tr>
<td>FONADE</td>
<td>Financial Fund for Development Projects (Fondo Financiero de Proyectos de Desarrollo)</td>
</tr>
<tr>
<td>FY2013</td>
<td>Fiscal Year 2013 (corresponding to the period October 2013 - September 2014)</td>
</tr>
<tr>
<td>FY2016</td>
<td>Fiscal Year 2016 (corresponding to the period October 2015 - September 2016)</td>
</tr>
<tr>
<td>GHG</td>
<td>Greenhouse Gases</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information System</td>
</tr>
<tr>
<td>GOC</td>
<td>Colombian Government or Government of Colombia</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>IADB</td>
<td>Inter American Development Bank</td>
</tr>
<tr>
<td>IGAC</td>
<td>National Geographic/Cartography Institute (Instituto Geográfico Agustín Codazzi)</td>
</tr>
<tr>
<td>IPS</td>
<td>Health Services Institute (Instituto Prestador de Salud)</td>
</tr>
<tr>
<td>IFMM</td>
<td>Incentive Fund Management Manual</td>
</tr>
<tr>
<td>IPSE</td>
<td>Institute for Planning and Promotion of Energy Solutions in the Non-Interconnected Zones (Instituto de Planificación y Promoción de Soluciones Energéticas para las Zonas no Interconectadas)</td>
</tr>
<tr>
<td>IR</td>
<td>Intermediate Result</td>
</tr>
<tr>
<td>JBB</td>
<td>Local Community Board for Energy Services Management (Junta Administradora de Servicios de Energía)</td>
</tr>
<tr>
<td>kW</td>
<td>Kilowatt</td>
</tr>
<tr>
<td>LCA</td>
<td>Environmental Credit Line (Línea de Crédito Ambiental)</td>
</tr>
<tr>
<td>LCOE</td>
<td>Levelized Cost of Energy</td>
</tr>
<tr>
<td>MADR</td>
<td>Ministry of Agriculture and Rural Development (Ministerio de Agricultura y Desarrollo Rural)</td>
</tr>
<tr>
<td>MADS</td>
<td>Ministry of Environment and Sustainable Development (Ministerio de Ambiente y Desarrollo Sostenible)</td>
</tr>
<tr>
<td>MHP</td>
<td>Micro hydroelectric power generator</td>
</tr>
<tr>
<td>MME</td>
<td>Ministry of Mines and Energy (Ministerio de Minas y Energía)</td>
</tr>
<tr>
<td>MONITOR</td>
<td>USAID/Colombia's Information and Monitoring System</td>
</tr>
<tr>
<td>MW</td>
<td>Megawatt</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-governmental Organization</td>
</tr>
<tr>
<td>OpEPA</td>
<td>Environmental Education and Protection Organization (Organización para la Educación y Protección Ambiental)</td>
</tr>
<tr>
<td>PAI</td>
<td>Indicative Energy Efficiency Action Plan (Plan de Acción Indicativo)</td>
</tr>
<tr>
<td>PERS</td>
<td>Sustainable Rural Energization Plans (Planes de Energización Rural Sostenible)</td>
</tr>
<tr>
<td>PEZNI</td>
<td>Energy Plan for Non-Interconnected Areas (Plan de Energización para Zonas no Interconectadas)</td>
</tr>
<tr>
<td>PIEC</td>
<td>Indicative Electricity Coverage Expansion Plan (Plan Indicativo de Expansión de Cobertura)</td>
</tr>
<tr>
<td>PINPESCA</td>
<td>Asociación de Pescadores y Piangüeras del Río Cajambre</td>
</tr>
<tr>
<td>PMP</td>
<td>Performance Management Plan</td>
</tr>
<tr>
<td>PPF</td>
<td>Clean Energy Project Preparation Facility (known in Spanish as Mecanismo para la Estructuración de Proyectos de Energía Limpia – Clean Energy Project Structuring Mechanism)</td>
</tr>
<tr>
<td>PTAR</td>
<td>Waste water treatment plant (Planta de Tratamiento de Aguas Residuales)</td>
</tr>
</tbody>
</table>
PROURE  Program of Rational and Efficient Use of Energy and Other Forms of Non-Conventional Energy (*Programa de Uso Racional y Eficiente de Energía y Fuentes No Convencionales*)

PV systems  Photovoltaic systems
QR  Quick Response Codes
RE  Renewable Energy
SELF  Solar Electric Light Fund (USAID Program)
SENA  Servicio Nacional de Aprendizaje
SGR  Royalties General System (*Sistema General de Regalías*)
SIN  National Interconnected System (*Sistema Interconectado Nacional*)
SIPERS  PERS Information System (*Sistema de Información para PERS*)
SME  Small and Medium Enterprises
T1  Task 1 - Renewable energy and energy efficiency enabling environment and institutional capacity development
T2  Task 2 - Expanding access to renewable energy sources in currently unserved areas
T3  Task 3 - Energy efficiency and renewable energy investment promotion
Tt  Tetra Tech (Prime Contractor)
UDENAR  *Universidad de Nariño*
UNIDO  United Nations Industrial Development Organization
UPB  *Universidad Pontificia Bolivariana*
UPME  Mining and Energy Planning Unit (*Unidad de Planeación Minero Energética*)
USG  United States Government
USAID  United States Agency for International Development
VAT  Value Added Tax
ZNI  Off-grid areas or Non-Interconnected Zones (*Zonas no Interconectadas*)
1. INTRODUCTION

1.1 PROJECT BACKGROUND AND RATIONALE

The $18.7 million United States Agency for International Development (USAID) financed Colombia Clean Energy Program (CCEP) was conceived as USAID’s Colombia’s flagship clean energy activity, falling under the clean energy pillar of USAID’s Global Climate Change Initiative. CCEP was implemented from 2012 to 2017, with a clear objective “to increase access to renewable energy sources and energy efficient practices in Colombia through a combination of project development support, technical assistance and enabling environment reforms.”

The Colombia Clean Energy Program started operations within a complex energy sector framework and through the implementation of its main three components, it helped improving a number prevailing conditions present in Colombia’s energy sector in early 2012:

- There was no sense of urgency by policy makers or any effective market mechanism to develop alternative renewable energy resources – the national energy generation mix was already perceived to be low emissions due to its dependence on hydroelectric generation.
- A similar lack of urgency prevailed regarding off-grid power expansion. According to the 2013-2017 Indicative Electricity Coverage Expansion Plan (PIEC), out of the 470,244 homes in Colombia without electricity, about 90,000 were thought could not be grid-interconnected within reasonable time.
- National policies and investment budgets for expansion of electricity coverage in off-grid areas (ZNI) were mostly limited to grid extension or diesel based generation with mini-grids, both increasingly expensive and subsidy-dependent. Alternative renewable energy and hybrid energy solutions for the ZNI were not considered.
- Energy efficiency policies and goals through various programs for the “Rational and Efficient Use of Energy” were primarily indicative, centrally formulated without involvement of energy consumers, and lacking financial incentives or other mechanisms to stimulate energy users to effectively curb energy waste.

1.2 AN INTRODUCTION TO CCEP

The Colombia Clean Energy Program supported implementation of the United States Government (USG) efforts to help Colombia increase access to renewable energy sources and energy-efficient practices through the three components described in this report. CCEP also included an incentive fund to promote investment in community-scale renewables and energy efficiency initiatives and help improve access to modern energy systems for underserved populations, household and community-scale renewables, and promoting an enterprise-based approach for these technologies.

Tetra Tech worked with representatives of many Colombian Government (GOC) institutions – including the Ministry of Mines and Energy (MME) and the Institute for Planning and Promotion of Energy Solutions in the Non-Interconnected Zones (IPSE) – regional environmental institutions (corporaciones autónomas regionals), municipal governments and organizations, local grassroots community organizations (consejos, cabildos) and private sector, totaling over 300 organizations.
1. Introduction

The three tasks described in this final report include:

- Task 1: Improve the Enabling Environment for Renewable Energy (RE) and Energy Efficiency (EE)
- Task 2: Expand Access to Renewable Energy Sources in Off-Grid or Under-served Areas
- Task 3: Promote Investment in Renewable Energy and Energy Efficiency

CCEP addressed one of USAID’s desired Intermediate Results (IRs), associated with “Mitigation of greenhouse gas emissions increased”, as shown in Figure 1 and Table 1. The CCEP’s Logical Results Framework.

Figure 1 CCEP’s Logical Results Framework
### Table 1 CCEP’s overall expected results

<table>
<thead>
<tr>
<th>Task</th>
<th>Expected Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task 1</strong></td>
<td><strong>Energy efficiency and renewable energy enabling environment and institutional capacity development</strong></td>
</tr>
<tr>
<td>Task 1</td>
<td>Enhanced capacity of MME, UPME, IPSE, energy companies, and regional institutions to formulate and implement renewable energy policies, programs and projects.</td>
</tr>
<tr>
<td></td>
<td>Revised policies for utilizing public sector rural electrification funds to attract private sector investment.</td>
</tr>
<tr>
<td></td>
<td>Enhanced capacity of Government of Colombia entities to develop energy sector specific components of a low emissions development strategy.</td>
</tr>
<tr>
<td></td>
<td>Financial mechanisms and incentives established to promote public and private investment in EE/RE projects.</td>
</tr>
<tr>
<td></td>
<td>Renewable energy and energy efficiency technologies and applications demonstrated and diffused to policymakers and general population through CCEP educational, awareness and outreach program.</td>
</tr>
<tr>
<td></td>
<td>2,000 people gaining or improving employment, directly or indirectly, as a result of clean energy program interventions.</td>
</tr>
<tr>
<td></td>
<td>Database of rural renewable resources and population centers established and managed by appropriate government, NGO, or academic institution.</td>
</tr>
<tr>
<td></td>
<td>Sustainable business models developed and implemented for rural renewable energy systems.</td>
</tr>
<tr>
<td></td>
<td>Sustainable community scale rural renewable energy and ZNI municipal seat electrification projects benefiting 16,000 beneficiaries.</td>
</tr>
<tr>
<td></td>
<td>Productive use activities developed in rural areas stimulating rural economic development, for example, cold-chain development or value-added product development utilizing clean energy.</td>
</tr>
<tr>
<td></td>
<td>20 rural energy service providers or community cooperatives trained in technical and business requirements for operating a community scale rural utility.</td>
</tr>
<tr>
<td></td>
<td>Quantitative impact evaluation completed highlighting impact of rural electrification programs.</td>
</tr>
<tr>
<td><strong>Task 2</strong></td>
<td><strong>Expanding access to renewable energy sources in unserved areas</strong></td>
</tr>
<tr>
<td>Task 2</td>
<td>Projects will facilitate energy savings, energy cost savings and renewable generation (number determined by recommendation of aforementioned analysis).</td>
</tr>
<tr>
<td></td>
<td>Significant project impacts in terms of energy and cost savings and improved competitiveness of Colombian industries.</td>
</tr>
<tr>
<td></td>
<td>Energy efficiency project transactions facilitated across range of sectors.</td>
</tr>
</tbody>
</table>

### 1.3 REPORT ORGANIZATION

The report’s following chapters (2 to 6) present summaries of each of the three technical task areas including activities and main accomplishments. Chapter 3 highlights CCEP’s major deliverables (both administrative and technical reports).

Chapter 4 demonstrates how CCEP performed against the program performance indicators that were not only achieved but in every case exceeded.

Chapter 5 focuses on the lessons learned during five intensive years of promoting and demonstrating the applicability, viability and social, economic and environmental benefits of integrating renewable
1. Introduction

energy and energy efficiency technologies and actions into standard practice by institutions, business and society.

Section 6 presents a summary of program expenditures and is followed by annexes elaborating all CCEP deliverables and providing other details over the life-of-program.

Finally, in order to further disseminate and leave a valuable public reference of the work accomplished by CCEP to local partners and GOC institutions, it was agreed with USAID that a separate three volume final publication would be developed as part of CCEP’s legacy for Colombia’s energy sector. These three volumes provide a comprehensive and detailed description of over 200 CCEP projects and activities as follows:

- **Volume I: Main Report** (Published in English and Spanish)
- **Volume II: Project Profiles** – a brief summary of the background, challenges, and opportunities behind each individual project or group of projects; its objectives, technologies, beneficiaries; roles and financial commitments of CCEP and counterparts; quantitative and qualitative results; lessons learned. Written by our technical project staff and management for energy professionals, researchers, students and institutional audiences, these 74 profiles cover over 200 direct CCEP interventions. (Published in Spanish)
- **Volume III: Select Project Chronicles** – written by external authors with journalist styles, these stories depict the human side and impact on daily life of a selection of 18 CCEP projects from around the country, through testimonies and perceptions of beneficiaries, allies and technical staff. (Published Spanish)

During the life of CCEP, team members travelled intensively to communities, industrial plants, training sessions and workshops throughout the country. As a result, over 60,000 photographs were taken at different phases of project identification, design, implementation and follow up. For some of our projects, professional film makers and photographers also registered fabulous images both as USAID documentaries and independent media coverage.

CCEP included in the three volume publication a selection of those pictures that “tell the story” but many others had to be left out for lack of space. And, of course, the videos cannot be printed.

True to the creative and innovative approach that has characterized CCEP, in those publications we integrated “QR codes” that will allow interested readers to complement their reading by accessing short videos and photo galleries directly from internet. Some of these videos were produced and published by partners or independent media and are referenced with their permission.
2. CCEP ACTIVITIES AND MAIN ACCOMPLISHMENTS

2.1 INTRODUCTION

USAID’s Colombia Clean Energy Program became an important player in the energy sector and acted as a catalyzing element during a transformational period of several key stages affecting clean energy and energy efficiency in Colombia. Over the course of CCEP’s implementation period, it provided technical support that made important contributions resulting in tangible impacts in the current legal, regulatory, financial, business and societal environment, particularly in the following key areas:

- **First tax incentives for energy efficiency issued.** In December 2012, UPME issued Resolution 563/2012, the country’s first tax incentive measure for energy efficiency investments (mainly for electric-powered public transportation and heat recovery and efficient motor substitution in industry), a long awaited measure since the 1990’s tax reforms enabling them as part of broader environmental contamination control incentives. The market responded promptly, and this resolution became the most effective measure to promote involvement and investment of the private sector in national EE/RE policy objectives derived from the 2001 PROURE Law 679 and 2010-2015 PROURE Action Plan. These two instruments had lacked measures to stimulate private sector response to energy savings or renewable energy government-proposed targets. In the first four years of being in force, a total of 86 investment projects worth US $869 million were submitted to UPME for tax incentive approval; 55% of the projects – totaling private investment of more than US $700 million to date – were approved (see Table 2). Most of the US $153 million in tax reductions approved were for mass transport projects (Medellín trolley, Bogotá hybrid buses and electric taxis), since incentives for the other types of projects were limited to heat recovery from combustion systems, substitution of inefficient motors with high efficiency electric motors, and renewable energy innovation or resource measurement projects.

The experience gained and results obtained in the transportation and industrial sectors since the passing of UPME Resolution 563/2012 demonstrate that there is a large potential market for private sector investment in energy efficiency and renewable energy, and that tax incentives can contribute significantly to reach financial closure, board of director approvals and bank finance for such investments.

- **New Law promoting alternative renewable energy and energy efficiency.** In May 2014, Law 1715 “By which the integration of unconventional renewable energy to the national energy system is regulated” was enacted. This legislation, and its regulatory and policy development to date, mark a huge departure from longstanding obstacles to other than large scale hydropower plants and energy efficiency investment:

<table>
<thead>
<tr>
<th>Category</th>
<th>Indicator</th>
<th>Industry</th>
<th>Transport</th>
<th>RE</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applications Received</td>
<td>Number of projects</td>
<td>34</td>
<td>30</td>
<td>22</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td>Investment (USD M)</td>
<td>231.6</td>
<td>599.2</td>
<td>38.1</td>
<td>868.8</td>
</tr>
<tr>
<td></td>
<td>Total Incentives Requested (USD M)</td>
<td>56.6</td>
<td>147.3</td>
<td>6.8</td>
<td>210.7</td>
</tr>
<tr>
<td>Applications Approved</td>
<td>Number of projects</td>
<td>13</td>
<td>25</td>
<td>9</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>Investment (USD M)</td>
<td>95.8</td>
<td>598.4</td>
<td>9.1</td>
<td>703.4</td>
</tr>
<tr>
<td></td>
<td>VAT (USD M)</td>
<td>4.0</td>
<td>95.5</td>
<td>1.5</td>
<td>101.0</td>
</tr>
<tr>
<td></td>
<td>Income Tax (USD M)</td>
<td>0.4</td>
<td>51.5</td>
<td>0.0</td>
<td>51.9</td>
</tr>
<tr>
<td></td>
<td>Total Incentives (USD M)</td>
<td>4.5</td>
<td>147.0</td>
<td>1.5</td>
<td>152.9</td>
</tr>
<tr>
<td></td>
<td>Ton CO2/year avoided</td>
<td>276.762</td>
<td>154.386</td>
<td>0.0</td>
<td>431.148</td>
</tr>
</tbody>
</table>

Source: UPME February 2017
2. CCEP Activities and Main Accomplishments

- **Large scale nonconventional renewable energy plants can now be integrated into the national grid.** UPME, which designs and manages the country’s indicative power expansion plan, reports that by the end of 2016, it had registered 3,557 MW of nonconventional renewable energy power generation projects projected for connection to the SIN (46% wind, 44% solar, 7% hydro as well). This is equivalent to 22% of current national installed generation capacity and 35% of all future generation capacity voluntarily registered by current and future generators – a far call from the 19.5 MW Jepirachi wind park.

- **Small and large scale self-generation and distributed generation will now be stimulated.** Self-generators, can now sell any excess electricity generated to the distribution grid. Cogeneration (combined production of electricity and thermal energy), bidirectional metering and demand response are also stimulated, which will enable new actors to enter the energy market near consumption centers – industry, shopping malls, residential units, individual homes – decreasing pressure on long-distance transmission lines from generation plants to market.

- **Renewable energy and hybrid renewable energy-fossil generation in off-grid zones (ZNI) will also be stimulated,** not just to decrease dependency on subsidized diesel generation systems but for other economic and logistical systems. CREG Resolution 004/2014 (ZNI tariff methodology under review) sets the stage to remunerate renewable energy and hybrid systems in competition to diesel and grid expansion according to Levelized Cost of Energy (LCOE) based on 24-hour service over 20-year periods rather than just installed generation capacity. In addition, MME Decree 1623/2015 unifies policies towards universal electricity coverage regardless of location within the SIN or the ZNI. It is now estimated that 50% of unserved households in the ZNI live in scattered individual dwellings, not susceptible to grid extension or service through isolated mini-grids, so individual photovoltaic systems are expected to become commonplace solutions for providing basic energy service in these remote rural cases. The National Planning Department (DNP) already issued a methodology for municipal and departmental governments seeking to apply to national royalties funding for individual household solar systems within their jurisdictions.

- **In August 2016, the government issued the last regulatory decree needed to implement the tax incentives designed in Law 1715:** up to 50% of investment costs of renewable energy and energy efficiency projects can be deducted from income taxes in the five-year period following the investment. For renewable energy projects, additional incentives include: import duty and value added tax (VAT) exemptions as well as accelerated depreciation (up to 20%/year). Over 4,600 people attended live and video stream workshops hosted in October and November 2016 by CCEP with UPME and ANLA to present and answer questions on the guidelines, procedures and eligibility of clean energy investment projects to apply for and receive these tax incentives. By mid-February 2017, in just a few months after completing regulations, UPME had already received 169 applications for Law 1715 tax deductions in the order of USD $41.1M for clean energy investment projects, with a total planned generation capacity of 1,215 MW – 7% of total installed capacity of 16,436 MW as of December 2016. Of these, UPME reports that incentives for 64 projects had been approved, 76 were under study, 25 just sought registration and only 4 had been rejected.

- **In December 2016, the MME and UPME issued the new “Indicative Energy Efficiency Action Plan (PAI-PROURE 2017-2022),** which broadened the scope of cost effective actions to
2. CCEP Activities and Main Accomplishments

additional technologies and equipment than those in the previous PAI and made energy efficiency technologies not encompassed in Resolution 563/2012 eligible for tax incentives. The new PAI begins by preceding the same four objectives PAI-PROURE 2010-2015 with “To define the most ‘cost effective’ indicative energy efficiency goals for each final energy user (sector), by energy source and final energy use equipment” and adds a sixth objective related to harmonizing this plan’s energy efficiency goals with the country’s UNFCCC COP21 commitments.

- In December 2016, CREG also issued Document CREG-161 for public commenting on Alternatives for the Integration of Nonconventional Renewable Energy Sources (FNCER) to the Generating Capacity, which presents the four alternative power auction mechanisms under final consideration focused on nonconventional (non-hydro) renewable energy generators and opening the door to accelerate incorporating these technologies in the country’s generation mix. Three of these mechanisms require prior GOC setting of policy targets for renewable energy MW capacity to be installed, while the fourth assumes renewables can compete with conventional power generators. Final decision on the mechanism and methodology to be applied for these auctions is expected by mid-2017 and long term contracts based on average or total energy delivery for alternative renewable generation are anticipated in the near future.

- Although as of early 2017 a number of decrees and resolutions derived from Law 1715/2014 were still under review and must be issued to enable its full implementation all signs indicate that the legal barriers to increase RE/EE have been significantly mitigated. This is particularly applicable to technical requirements for delivery of excess power to the grid, remuneration schemes for distributed generation sales and renewable energy power auctions. Installation of small and medium scale projects in or near consumption centers have already started and they are receiving the benefiting from incentives already in place. Nonetheless, it is unlikely that large scale RE developments will occur within the next few years due to:
  - Lack of transmission lines from the northern region with RE-rich departments such as La Guajira and Magdalena (mostly wind and solar) to the national grid;
  - The financial, environmental and social consultation processes and permits needed to implement them; and
  - The long construction and installation times.

USAID’s Colombia Clean Energy Program is pleased to have been able to provide technical assistance and specific actions and projects to contribute to this new era in renewable energy and energy efficiency in Colombia.

2.2 PROGRAM APPROACH AND IMPLEMENTATION STRATEGY

2.2.1 Program approach

The Colombia Clean Energy Program approach evolved over the course of its implementation, from 2012 to 2017. This evolution was progressive and beneficial as it adapted to local realities found on the ground. This evolution was based on feedback and experience gained by the team and USAID while working with Colombian institutions, communities, and businesses on specific clean energy projects and activities, as well as the opportunities arising from a changing policy climate.
Through the implementation period, the Colombia Clean Energy Program never lost focus of the overall objective to motivate increased access to renewable energy sources and energy efficient practices in Colombia, and the conviction to achieve this through a combination of technical assistance, project development support, capacity building activities, and the promotion of an enabling environment. This chapter documents how the program team approached and followed through this objective.

CCEP also maintained the operational structure by work areas or tasks in line with the contract requirements, as depicted in Figure 2.

Under the first task associated with overall enabling conditions, CCEP promoted a favorable environment and improved organizational capacity within government agencies, private enterprise, rural communities, academic centers, media and society at large in incorporating renewable energy technologies and energy efficiency practices into mainstream policy and action. Under this task, CCEP worked to change the enabling environment for clean energy policy, investment and societal support. Through CCEP initiatives, technical assistance, and institutional partnerships, by 2017 much had been accomplished as explained in this report.

The next two tasks were on our “seeing is believing” work fronts, focusing on the design and development of concrete investment projects to demonstrate the viability, sustainability and benefits to be derived from renewable energy projects in ZNI communities and energy efficiency/renewable energy projects in industrial, agro-industrial and other private sector establishments. These projects had immediate and projected impacts on the community life of thousands of Colombians in isolated indigenous, Afro-Colombian and peasant communities in the ZNI, and also resulted in energy, cost, and emissions reductions in over 50 participating industrial and demonstration installations over the expected life cycle of the technologies installed. CCEP performance indicators described in Chapter 4, project profiles and chronicles (included in Volumes 2 and 3 of the separate final publication) present these quantitative, technical, and social results. Just as importantly, the methodologies and
2. CCEP Activities and Main Accomplishments

technologies employed, the difficulties encountered and surpassed, and the results obtained benefit not only the individual communities or companies involved, but also provide valuable evidence of growing interest and feedback in support of national and regional planning and policymaking as well as private sector decisions on investment in clean energy.

Each task was carried-out by multidisciplinary teams of well-versed Colombian professionals located in Bogotá (Task 1), Cali (Task 2) and Medellín (Task 3) under the overall technical leadership and articulation with the government and USAID in Bogotá. At the beginning of CCEP, the teams set about to engage national energy institutions, regional development agents, rural communities and private sector industrial and financial agents in implementing a comprehensive agenda of activities based on the objectives, tasks and subtasks foreseen during program formulation and approved in CCEP’s first 18-month work plan.

During 2012, CCEP had to deal with both unplanned realities – which slowed down development of Task 2 and Task 3 field projects – and new opportunities to intensify and accelerate policy and planning aspects under Task 1. This led to a strategic review of the program between the team and USAID in March 2013, resulting in important adjustments to the technical approach, implementation procedures and program targets during the remainder of CCEP.

2.2.2 Implementation strategy

This section focuses on the main elements of the implementation strategy, which builds upon the progressive experience during the life of CCEP:

- Interaction and feedback among the three tasks
- Hands-on focus - less theory and more practice
- Transfer of know-how
- Alliances and partnerships
- Mobilization of Public and Private Sector Funds
- Sustainability
- Adaptability and Perseverance

a. Interaction and feedback among the three tasks

Interaction and feedback amongst the three tasks. Field Tasks 2 and 3 provided valuable data and evidence to support Task 1 policy, planning, regulatory and demonstration work, while Task 1 provided guidance, methods and allies for Task 2 and 3 fieldwork. The rural energy project experience, for example, helped shape the individual household solar system policy and empirically demonstrate to policymakers and planners how hybrid systems, prepaid meters and community energy service organizations can be implemented in the ZNI. Task 3 feasibility studies and financial modeling helped shape the regulatory decrees, evaluation methodologies and roll-out manuals and workshops for EE/RE tax incentives developed under Law 1715. The texts and illustrations in these volumes clearly show that regardless of the different contexts, audiences or specific objectives of our varied interventions, CCEP worked as a single team with the unified purpose of making clean energy happen.

b. Hands-on focus - less theory and more practice
2. CCEP Activities and Main Accomplishments

Even in Task 1, which could have worked only with central institutions in the comfort of theory, CCEP took a concrete project approach and put into practice planning tools, methodologies and clean energy technologies through empirical regional and national efforts. Its Task 2 rural renewable energy projects were aimed not just at solving particular community challenges through clean energy technologies, but to demonstrate key concepts of (a) community involvement in renewable energy initiatives from project conception through all phases of implementation and post-CCEP operation and management; (b) internal appropriation or “ownership” by communities and institutional allies; (c) sustainability of solutions; and (d) replicability and continuity of intervention models and technologies installed. Task 3 energy efficiency projects focused on “mainstreaming energy efficiency in the economy” through specific investment projects, effectively reducing fossil fuel consumption and emissions per unit of output, rather than focusing on energy audits, energy management systems or “best practice” recommendations requiring only changes in human behavior patterns rather than inefficient technologies.

c. **Transfer of know-how**

CCEP placed great emphasis on the mobilization of expertise and transfer of knowledge through (a) the recruitment of a highly motivated, expert team of CCEP professionals and consultants, fully capable and committed to providing solid, sustainable solutions to each challenge faced, and (b) the systematic emphasis on training, capacity building and, particularly in Task 2, strengthening community entrepreneurial organization.

d. **Alliances and partnerships**

International cooperation programs such as CCEP inevitably come to an end, and their success can best be measured in terms of what follows after completion rather than just during implementation itself, when CCEP technical and financial resources can provide support and help find solutions to the problems that arise. This is why from early on during the program, CCEP began to form alliances and partnerships with national and regional institutions – public sector, private enterprise and/or community organizations – which would endure over time, share CCEP’s interest in the sustainability of endeavors and provide the necessary post-implementation support.
CCEP established alliances and partnerships with over 300 implementation partners. As indicated in Figure 3 of those 80 were public institutions, 90 community organizations & NGO’s (Figure 4), and 126 from the private sector (Figure 5).

In the case of policy and planning projects, institutionalization was CCEP’s greatest focus. In the case of demonstration and educational projects, the participating beneficiaries all have budgets, motivation and technical know-how of their own, or access to whatever know-how is needed, to sustain and expand the seeds planted. In the case of industrial or commercial installations, the enterprises themselves take over the operations and maintenance of EE/RE installations supported by CCEP as part of their valued assets. Appendix A present the full list of CCEP’s partners.

It is in the case of rural renewable energy projects where allies and partners of at least two types were carefully engaged with to ensure the long-term sustainability of solutions. To all communities involved, CCEP provided strong socio-entrepreneurial training and capacity building; technical operations and maintenance training; and tariff and income generating models seeking to guarantee sustainable administration, operations and routine maintenance. Besides channeling co-financing to the projects implemented, the institutional partners engaged, generally have the technical, administrative and financial capacity, as well as their own stake in the communities benefitted, to assist them in solving more complex technological challenges, insurance claims or major repairs that may be required.

e. Mobilization of Public and Private Sector Funds

Mobilizing of public and private sector resources proved to be a key strategy for achieving CCEP goals. CCEP was able to leverage and mobilize USD $19.8 million of Colombian funds channeled into concrete projects in rural renewable energy, industrial energy efficiency, planning and policy development and RE/EE demonstration and education – a ratio of USD $3.43 for every USD $1 directly by CCEP into the same projects and activities. As illustrated in Figure 6, CCEP was very successful in terms of mobilizing private sector investment in energy efficiency and renewable energy projects. It also managed to achieve public co-financing for engineering and financial structuring of some of those private sector projects. Public sector investment in CCEP Task 1 projects and technical activities, such as regional rural energy planning, surpassed public investment channeled into rural renewable energy projects, though the latter was somewhat compensated by the mobilization of funding by private sector energy companies and civil society (community based groups and NGOs).
2. CCEP Activities and Main Accomplishments

f. **Sustainability.**

CCEP’s approach to challenges and solutions explicitly sought to guarantee environmental, technological, economic-financial, socio-cultural and organizational sustainability. From discussions on tax incentives or tariff methodologies for ZNI service providers to each investment project undertaken or designed in the country, the CCEP team and consultants persistently pursued sustainability.

\[\text{Investment mobilized by public, private and civil society sectors by Task}\]

<table>
<thead>
<tr>
<th>Task</th>
<th>Community Organizations &amp; NGOs</th>
<th>Private Sector</th>
<th>Public Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3,325</td>
<td>64,963</td>
<td>4,123,961</td>
</tr>
<tr>
<td>2</td>
<td>294,896</td>
<td>250,601</td>
<td>3,668,625</td>
</tr>
<tr>
<td>3</td>
<td>231,775</td>
<td></td>
<td>11,185,697</td>
</tr>
</tbody>
</table>

\[\text{Figure 6}\]

\[\text{Figure 7 and Figure 8 illustrate the national coverage, locations, and diversity of projects and activities including PERS, solar, micro hydro, boilers, kilns, PPF, water pumping, demonstration projects, educational, telemedicine, organizational strengthening, and engineering studies.}\]
2. CCEP Activities and Main Accomplishments

Figure 7 Diversity and coverage of projects and activities - north-western area
The following sections describe in detail the main activities and accomplishments under each of the three main components of the program.

2.3 TASK 1: RENEWABLE ENERGY AND ENERGY EFFICIENCY ENABLING ENVIRONMENT

The Colombia Clean Energy Program worked on over 200 projects and technical activities with a diversity of individual communities, companies, national and regional institutions, universities, etc. This section describes CCEP’s Task 1, its progression over time and key achievements. More details on individual projects or activities can be found in project profiles in Volume 2.

2.3.1 Work Stream 1.1: Renewable energy planning, policy and project evaluation and development methodologies.

Starting in 2012, CCEP began to work together with energy sector agencies and research centers to assess challenges and identify opportunities to insert renewable energy and energy efficiency in planning methodologies, policy design and institutional action.
Regarding renewable and rural energy, early on it became apparent that national agencies worked quite independently of each other, with little interaction, limited field presence and separate, and generally using contradictory databases.

Main accomplishments regarding renewable and rural energy include:

**Developed Sustainable Rural Energization Plans (PERS).** UPME was from the start CCEP’s main technical counterpart and partner in Task 1. Regarding renewable energy and off-grid rural households, information and planning tools were lacking, so by the end of 2012, UPME and CCEP had agreed on testing a unified approach to developing comprehensive planning tools at a subnational level, more manageable to operationalize than for the whole country. The final objective was to develop new instruments to design a 15-year Sustainable Rural Energization Plan, PERS for its Spanish acronym in different regions.

CCEP organized and supported the design of a Sustainable Rural Energization Plan for the Department of Nariño (PERS Nariño). This work included carrying out over 3,000 household, small industrial, commercial and service sector surveys representative of 13 subareas, creating a geographic information system with energy demand and energy resources data, refining methodologies to collect and create such system, including an assessment of local productive activities. Additional details are included in the Task 1 project activity summary Table 4. Through this work CCEP brought together resources and further improved capabilities of several national and regional institutions with the objective of creating a sustainable rural energy strategy and project portfolio for the specific needs and renewable resources of the Nariño region. The success of this approach led to the formulation of other regional PERS projects to be implemented in the departments of Tolima, La Guajira, and others as described below.

CCEP organized and supported the design of a Sustainable Rural Energization Plan in 12 other Departments. What began as a methodological exercise in Nariño became the heart of CCEP work on RE and EE strategic planning and policy, since it is a replicable set of unified methodologies, designed and shared nationally, that combine planning, policy-making, project evaluation, and development strategies to harness renewable energy for rural development in sub-national areas. This work became a model of bottom-up regional energy planning in 2-way interaction between regional and national institutions. The PERS process counts on the participation of not only regional actors, but with technical and financial support from national government agencies, under the overall leadership of UPME. As the PERS process has consolidated, national institutions such as MME, MADS, MADR, DNP and Ministry of Foreign Affairs have joined the initiative from their respective perspectives.

In this context, CCEP also worked with the Office of the High Commissioner on Post Conflict. The High Commissioner’s Office became particularly interested in the PERS methodology, as it offers a hands-on approach to energy sources available at the local level and assists in formulating projects to help resolve energy demand in their target areas. On the practical side, CCEP supported the Office of the High Commissioner, by visiting projects to demonstrate the deployment of rural energy solutions in

“Perhaps the greatest achievement of the PERS process is not the wealth of information and results presented, but actually the responsibility assumed in the different regions to deeply analyze their current state and plan their own futures regarding rural energy development” UPME director, Jorge Valencia
remote locations; assisting in the identification of many rural energy initiatives; helping in budgeting scenarios to establish the cost of an operational unit and the implementation of social infrastructure projects similar to CCEP’s Task 2 renewable energy interventions.

It is expected that the Office of High Commissioner on Post Conflict will be fundamental in the implementation of the Peace Accord, in conjunction with Plan Pacífico, the Ministry of Mines and Energy (Ministerio de Minas y Energía - MME), IPSE and UPME and the agricultural sector (the Ministry of Environment and Sustainable Development / Ministerio de Ambiente y Desarrollo Sostenible - MADS, the Financial Fund for the Agriculture Sector / Fondo para el Financiamiento del Sector Agropecuario - FINAGRO, etc.).

Completed technical assistance to CREG regarding the off-grid (ZNI) Tariff methodology reassessment. CCEP assisted CREG to carry out an independent renewable energy resource assessment and mapping analysis including an estimation of associated costs of renewable systems vs. standard diesel or hybrid systems taking into consideration regional differences and market sizes to compare the levelized cost of energy (LCOE). Results were used by CREG to verify, modify and issue a new tariff methodology for the ZNI by early 2014 (Resolution 004 of February 2014). An important partner during the implementation of this activity was the National Geographic/Cartography Institute (IGAC), the national authority on geographic information systems which provides technical standards in the development of the Mines and Energy Sector Geo-Portal ensuring that the whole energy sector benefits from the results achieved. Additional details are included in the Task 1 project activity Table 4.

Supported the development of technical standards for household photovoltaic (PV) systems. CCEP provided support to MME to establish technical norms for residential photovoltaic systems (PV systems) which was incorporated into CONPES 3856. CCEP presented results to MME, UPME, IPSE and DNP and the proposal defined elements required to install photovoltaic (PV) systems in ZNI; recommendations to take into account in the design, installation, and maintenance of PV systems; an overview of energy needs in rural housing; and an indicative sizing and costing model for specific regions. This information was essential input to the publication by DNP of the official guidelines for formulation of individual PV system projects in the ZNI requesting royalties funding from the SGR. DNP integrated and published the technical norms as a DNP guide to formulate PV systems projects in isolated areas. The guide provides instructions to formulate projects to install PV systems in ZNI with at least 20 connections (20 households). The guide is available at [https://proyectostipo.dnp.gov.co/index.php?option=com_k2&view=item&id=159:21-instalacion-celdas-solares-en-zonas-no-interconectadas&Itemid=114](https://proyectostipo.dnp.gov.co/index.php?option=com_k2&view=item&id=159:21-instalacion-celdas-solares-en-zonas-no-interconectadas&Itemid=114).

Supported the development of technical standards for small-scale distributed generation systems. CCEP’s support was used by the MME to structure the regulatory decree on small-scale self-generation and distributed generation, which sets policy guidelines for these activities. In addition, CCEP provided technical assistance to implement these technical standards for small-scale distributed generation in a PV system provider in Dosquebradas, Risaralda. Results showed 50% reduction in energy consumption from the city grid. In the near future, the PV system will be

“We take this opportunity to thank the support provided by USAID associated with the work done for drafting proposed technical regulation and recommendations for injecting power into distribution grid for general use by distributed generators, which was the basis for the final proposal presented”, MME, RETIE David Aponte
2. CCEP Activities and Main Accomplishments

connected to the national grid that, using a bidirectional meter, will provide energy to Pereira’s energy service provider.

Regarding energy efficiency early on it became apparent although there were some policies and programs were in place\(^1\), but these policies and goals were just indicative, centrally formulated without involvement of energy consumers, and lacking financial incentives or other mechanisms to stimulate energy users to effectively curb energy waste. The lack of institutional arrangements to assume leadership and channel resources to the indicative plan made it unlikely to have major effect among energy consumers and government establishments, expected to modify their energy consumption patterns. The main accomplishments regarding energy efficiency include:

**Supported and completed development and roll-out of National Tax Incentive Regulation (UPME Resolution 0563, 2012).** One of CCEP’s most significant accomplishments early in the program was its critical involvement in the development and roll-out of the Tax Incentive Resolution 0563 promulgated by UPME in December 2012. CCEP’s support also included initial evaluation of energy efficiency project applications received by UPME through September 2013, by which time UPME had developed internal capacity and funding procedures to handle additional requests. In conjunction with UPME, MADS and ANLA, in early 2013, CCEP also designed and implemented outreach seminars in 6 cities to roll out these first tax incentives for EE/RE investment in clean transportation and industrial energy efficiency measures. Hundreds of technical, financial and legal attendees were led through the process of formulating eligible projects, the evaluation criteria and the applications process through UPME and ANLA, to achieve these incentives.

In the four years since the resolution was enacted, clean energy investment projects worth more than $700 million have received approval for tax cuts worth $153 million, with an anticipated reduction of more than 430,000 tons of CO2e per year over equipment life time. This proves two points. First, there is definitely a market for energy efficiency investment in Colombia. Second, tax incentives are a strong driving force for these investments, making financial sense for companies and economic and environmental sense for the society, judging by their effectiveness in terms of emissions abatement and concomitant energy savings. Additional details are

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\(^1\) Program of Rational and Efficient Use of Energy and Other Forms of Non-Conventional Energy (PROURE-2003) and the ensuing PROURE 2010-2015 Indicative Action Plan (PAI-PROURE)
2. CCEP Activities and Main Accomplishments

Included in the Task 1 project activity summary Table 4 and in Appendix B documenting some of the success stories submitted for USAID.

**Assisted the GOC teams designing the regulatory decrees to implement the tax component of the Law 1715.** CCEP’s technical and financial team became directly involved in assisting the GOC teams designing the regulatory decrees to implement the tax component of the law. CCEP became involved at the specific request of the Minister of Mines and Energy, and the acceptance of project allies with which it had structured detailed engineering and financial designs under nondisclosure agreements for large scale renewable energy and energy efficiency investments. The companies involved authorized CCEP to use the detailed budgets for several investment projects structured as well as company accounting information such as tax shields to develop economic models to assist in the analysis of alternative regulatory interpretations and clauses under discussion among financial, tax, energy and environmental authorities during the design of Decree 2143 of 2015. Without ever disclosing confidential data, CCEP models helped discern issues such as the applicability of VAT exclusion for imported components versus national components, and the concurrency of income tax deductions with accelerated depreciation. In the end, CCEP and the authorities concluded that the regulatory decree would enable cost reductions in the order of up to 25 to 30% of the investment required to implement renewable energy and energy efficiency projects, enough to spur the onset of clean energy installations throughout the country.

The ensuing resolutions by UPME and MADS issued in 2016 were followed up by CCEP in the form of a guidebook on the application to the new tax incentives and a series of 7 workshops attended in four major cities by over 1,386 participants in October and November, repeated by web streaming to 3,572 participants throughout Colombia and abroad.

The market response to these tax break regulations and roll-out was immediate. After two years of waiting – during which many projects were postponed and others were being designed and negotiated – in just a few months, companies and individuals presented UPME with 169 tax incentive applications under these procedures. The applicants registered projects adding to a total of 1,207,495 kW in renewable energy power generation capacity. Biomass projects, with 560 MW, lead the register. Wind projects following with 376 MW and geothermal show a strong third, with around 196 MW.

**2.3.2 Work Stream 1.2 RE Resource assessment mapping and technological tools for information management.**

The Colombia Clean Energy Program provided technical support, mainly through the PERS process described before, to develop tools for mapping and information management.

**Completed design and implementation of national information system for PERS called- SIPERS for its Spanish acronyms.** SIPERS allowed to unify and integrate databases, maps, and relevant documents associated with the regional PERS (current and future). SIPERS is a unified PERS
information system, which was finalized by end of 2016 thanks to data mining and database programming by CCEP consultants to unify individual PERS databases. The system provides aggregated results by department and region for average energy variables and demand factors per energy source. Socioeconomic variables are also available, with information about average household size, income levels, and NBI indicators. Demand, supply, and other statistical variables, are available accessing each individual PERS information system.

One of SIPERS’ greatest advantages is its modular design, which permits future PERS fieldwork to be incorporated into the main system. Currently the system incorporates field results from Nariño, Tolima, La Guajira and Chocó; data resulting from Cundinamarca, Cesar, Orinoquia, and Putumayo will be incorporated by designated partner teams. CCEP presented SIPERS to UPME in December, thus strengthening the institution’s medium and long-term planning strategies.

**CCEP developed a Geographic Information System.** This system was conceived to manage geo-referenced information gathered during project implementation – from spatial information collected by fieldwork staff in each rural location to the characterization of energy sources and renewable energy projects – or projects implemented in Colombia during the past 20 years. Main partners and counterparts were IPSE, UPME, and PERS regional teams.

### 2.3.3 Work Stream 1.3 Technical assistance in achieving, complementing and monitoring PROURE energy efficiency targets

**Completed performance assessment of 2010-2015 PAI-PROURE and provided technical support for monitoring/evaluation proposals.** From 2013 to mid-2014, CCEP performed an evaluation of PAI-PROURE’s implementation progress, analyzing its 27 subprograms and 162 action lines, international experiences and a 35-question on-line perception survey responded by 323 persons working in industry, energy sector companies, academia and public agencies involved. CCEP formulated recommendations to prioritize, monitor and evaluate impacts, intended as inputs towards the formulation of the next PAI-PROURE, but the passage of Law 1715 in May 2014 making the promulgation of a PAI-PROURE with additional considerations, and the change in Minister of Mines and Energy later that year, led to questions on who, how and when a new action plan would be issued. CCEP did not provide technical assistance to the PAI-PROURE 2017-2022, published in December, 2016.

### 2.3.4 Work Stream 1.4 Support in establishing financial mechanisms for EE/RE investments in industrial, commercial or other strategic sectors

**CCEP created and operated a Clean Energy Project Preparation Facility (PPF) an independent mechanism that facilitates private sector investment in EE and RE.** A mayor CCEP contribution in RE and EE strategic planning and policy is the PPF, an independent mechanism aimed to co-finance basic and detailed engineering designs and financial structuring of EE/RE projects as well as high-level decision-making assistance to reach bankability and financial closure of abundant “project ideas”.

CCEP designed the PPF, to surpass these valid internal obstacles that impede clean energy project proposals reaching financial closure, management approval and financial institution banking, by (a) co-financing up to 50% of the cost of basic and detailed engineering designs with companies and ESCOS; (b) complementing engineering designs with detailed financial modeling with investment bank expertise; and (c) assuring channels of communication with company owners or top management.
The PPF was originally proposed as a sinking fund with an endowment of resources from international donors, multilateral and national financial institutions and government, an operational horizon of 7-10 years and a business plan based on feedback received from these agents plus companies and ESCOS involved in EE/RE projects. However, the only potential partners that did not seek to use the PPF to generate business opportunities for themselves were USAID and UPME, neutral governmental bodies interested in societal objectives, independent of technology or credit providers nor potential beneficiary companies.

Except for the cost-recovery sinking fund aspect, due to the public funds nature of their financial resources, the PPF mechanism was implemented by CCEP in partnership with UPME from 2014 through 2016. The mechanism was announced in several business and energy sector scenarios, and public calls for proposals to co-finance and technically assist companies in structuring solid EE/RE projects. A joint UPME/CCEP PPF technical committee was designated by respective directors, and over 30 committee sessions were held during two years to steer the process and discuss each project’s progress. The committee developed and published standard project application procedures; eligibility, pre-selection and evaluation criteria both for projects and for engineering firms; and supervision, monitoring and financial structuring assistance. Furthermore, CCEP set up a PPF unit of highly experienced engineers and financial experts to accompany each study through all phases, from application to final analysis, verification and approval of each deliverable and final designs. CCEP-PPF engineers and CCEP management undertook countless site visits to company installations and administrative teams, providing technical inputs and earning company trust. Where possible, the PPF’s financial specialists assisted companies in the financial structuring of investments designed. Finally, CCEP management and PPF staff continually followed up with beneficiary company technical and managerial teams on their decision making process and any hurdles to overcome that we could assist with.

Of more than 80 potential study proposals received through public calls and about 30 company installations visited to analyze proposals, the PPF committee and UPME/CCEP directors approved, co-financed and technically accompanied the structuring of 15 industrial and 2 commercial sector clean energy investment projects. Information on the projects structured themselves, the investment made by USAID, UPME and the private sector in the engineering and financial studies, the magnitude of projects structured and their potential impact in terms of greenhouse gas emissions is presented in section 4.3 in the context of our energy efficiency Task 3. For now, suffice it to say that for every $1 invested between UPME, USAID and the participating companies in the technical and financial designs, the PPF structured $143 worth of energy efficiency and renewable energy investment projects. At least half are sufficiently technically advanced and financially attractive to have become part of the investment plans of the participating companies for implementation in the near term. The PPF experience shows that by facilitating the technical and financial structuring of clean energy investment projects, and establishing communications lines with management, high impact projects can be developed in private companies.

Since the PPF mechanism is an innovation worth maintaining and propelling, all PPF files and operations were transferred to UPME in the first quarter of 2017, and at the time of writing discussions were ongoing with the National Financial Development Corporation (Financiera de Desarrollo Nacional – FDN) and UNIDO to extend and expand the energy efficiency after CCEP closes.

Additional details are included in the project activity summary Table 10.
Identified and consolidated private, regional and other programs’ co-financing. CCEP was successful in decreasing dependency on a single GOC agency (IPSE) for co-financing even its Task 2 rural energy projects. Given that rural communities do not normally have resources to co-finance 50% of projects, CCEP partnered with a steadily increasing number of allies. This initial decision quickly led to the design and implementation of the San Antonio project with the social foundation of the Diocese of Riohacha. Two specific indigenous community projects with CVC, and other partnerships for joint project implementation with private sector Cerrejon Foundation in La Guajira, CELSIA/EPISA in Punta Soldado, Buenaventura, and the Coffee Growers’ Federation (Fedecafe) in the Serrania de Perija.

2.3.5 Work Stream 1.5 Support in overcoming regulatory and financial barriers to EE/RE power generation and distribution

Supported HOMER modeling and training. Development of cost analysis models for evaluation of renewable energy and hybrid system options using standardized HOMER software for the design of CCEP projects; transfer of modeling experience and/or training in HOMER model to UPME, CREG, IPSE, EPM, EPSA and PERS teams.

Completed training components in Iluminando, a private-sector project to encourage rural entrepreneurs in off-grid locations to distribute solar lanterns using innovative commercialization schemes. CCEP partnered with Iluminando, a private-sector initiative that promotes the use of solar lanterns in off-grid communities as a commercial endeavor. Iluminando donated the first lot of solar lanterns for participating entrepreneurs, while CCEP financed technical assistance and training components to work with crafts women associations in La Guajira, supported by partner FCGI and local hardware stores in Palmor. Both locations offer the conditions for growing markets throughout La Guajira and Sierra Nevada de Santa Marta. Individual solar powered lamps and charging systems solve basic needs for night lighting and cell phone charging in remote and off-grid communities. This technology is sufficiently low-cost to be affordable by rural households; however, commercial distribution and market development is extremely limited. Companies and distributors of solar technology prefer to commercialize larger, higher-cost, higher-profit PV systems, accessible only to higher-income populations and institutional programs in off-grid areas. Furthermore, distribution costs of reaching isolated rural markets present a challenge.

2.3.6 Work Stream 1.6 Support to GOC’s capacity to develop low emissions development strategy (LEDS) process

Provided technical support to Ministry of Mines and Energy, National Planning Department and Ministry of Environment NAMAS and LEDS consultants. CCEP supported the LEDS process in Colombia mainly through support on specific topics requested by the MME’s LEDS consultant and the organizers of a series of EC-LEDS seminars and workshops covering clean energy topics. Support has ranged from making presentations and participating in these workshops to contributing to the design, formulation and development of a NAMA for ZNI. As the EC-LEDS process moved ahead, perspectives for specific joint action have been identified with the MADS/USAID’s consultancy teams in agriculture (energy efficiency in “trapiches pameleros”) and expanding PROURE’s actions to the transport sector in conjunction with the Ministry of Transport’s EC-LEDS initiatives.
2. CCEP Activities and Main Accomplishments

2.3.7 Work Stream 1.7 Renewable energy and energy efficiency educational, awareness and outreach program.

CCEP developed high-impact educational and demonstration projects to showcase RE/EE technologies, raise awareness among the general public and policymakers and promote clean energy solutions to present-day challenges. CCEP demonstration projects are full-scale, operating technological installations available to be visited and studied by thousands of researchers, students, professionals and government or business staffs.

**Designed and implemented a biomass gasification and solar thermal technologies.** This projects was implemented in the highly visible venue of the Bogotá Botanical Garden (BBG), where sustainable solar water pumping, biomass gasification and solar thermal technologies and educational applications (APPs) on RE technologies were developed over the last three years. The BBG is the entity in charge of the maintenance and repopulation of 1,115,000 trees in Bogotá, which generates a volume of 15,000 tons of biomass per month, whose total disposition prior to the project was in the city’s landfill, destined to generate methane emissions. With the desire to make use of this biomass to self-generate up to 30% of the Garden’s electricity demand and establish a biomass recycling area within its grounds for research and educational purposes, CCEP and JBB partnered in implementing two 20-kW gasification and grid-connected power generation sets in a specially designed building on one of its study paths. The project included wood chip preparation and solar drying facilities, operator training and an educational APP extended to other renewable energy facilities in the Garden. CCEP and BBG also installed 9.8 kWp of grid-connected photovoltaic panels on the roof of the gasifier building to generate electricity for the Garden’s water cycle. Besides receiving an average of 23,000 visitors per month, mostly school students, the renewable energy installations are available to researchers and university students working on different botanical, mechanical, electronic and other aspects of the technology.

The Colombia Clean Energy Program also developed a custom-made APP to educate visitors about clean energy solutions installed and natural resources’ potential to produce renewable. CCEP and BBG viewed this joint effort as an excellent opportunity to build public awareness of the benefits of renewable energy and through it we expect that clean energy solutions will have a huge educational impact within the city of Bogota and the nation, and will contribute towards CCEP’s objective of increasing awareness through tangible projects, promoting investment in renewable energy sources and improving energy efficient practices in Colombia.

Additional details are included in the Task 1 project activity Table 4.
2. CCEP Activities and Main Accomplishments

In CCEP’s final year, it held a national competition among universities, research centers and NGOs to develop and implement additional demonstration and educational projects. Three of these projects were selected by a panel of judges and implemented in the course of 2016:

**Supported installation of a fleet of 60 solar-powered electric bicycles, together with a 13 kWp solar photovoltaic array to recharge them in a bicycle parking facility to demonstrate sustainable clean energy transport systems in Pasto.** The project promotes the use of electric bicycles charged with solar energy to move on and off campus and trains university faculty and students on the uses of clean energy in transportation, among other topics. The bicycles are available to students through a loan system managed by the student welfare department, similar to borrowing library books. The project was proposed by the same team at UDENAR in charge of the PERS Nariño and PERS Putumayo projects, who have already won two national awards for innovation in the power sector (Premios Ambar 2014 and 2016) and an international IADB contest for the design of solar power installations for over 100 rural schools in Nariño. The UDENAR team incorporated an electronic monitoring system to track each bicycle’s routes, usage and recharging cycles. This project not only showcases the advantages of clean energy, but also promotes small investments to improve mobility, a critical element in mid-sized cities like Pasto.

**Supported installation of a solar absorption air conditioning system.** System was designed for a 300 m² building on the campus of the Universidad Pontificia Bolivariana (UPB) in Medellín, a university with decades-long tradition in energy efficiency and renewable energy. UPB designed a system using a solar air conditioning system, which will avoid installing a conventional electric powered air conditioning system in one of its buildings in campus. The state-of-the-art technology has great replication potential, as it can be used for air conditioning systems in hotels, hospitals, and office buildings across the country. Implemented by a specialized research team partially funded by the national science institute COLCIENCIAS, this was their opportunity to scale up laboratory and computer modelling of solar thermal applications to provide air conditioning to buildings in warm climates of Colombia.

**Implemented “Dinamos” an educational program that incorporates instructional contents and RE/EE demonstrative applications into environmental sciences curricula.** Dinamos, “colegios que se renuevan con energía” is an educational program with CCEP support that targeted 16 schools with over 19,400 students in eight municipalities of Cundinamarca. The project, in alliance with Cundinamarca’s Education Secretariat, offers an innovative hands-on approach to natural science materials, delivers theoretical and practical knowledge on topics such as renewable energy, energy efficiency, and climate change, and integrates the use of Information and Communication Technologies APPs and renewable energy building kits to facilitate knowledge transfer for elementary, middle, and high school teachers and students. Students involved in the project have gone on to apply the knowledge and skills obtained to their homes and communities, for example recharging cell phones with static bicycles they’ve set up in school yards, or exhibits at local fairs. The Education Secretariat and ALECOP
expect to expand the project throughout the department of Cundinamarca after evaluating this trial, which involved 81,604 person-hours of training to 80 science teachers and 5 grades of science classes at each participating school.
# Table 4 Task 1 – Summary Project Activity Table – March 2017

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<td><strong>Project</strong></td>
<td><strong>Description</strong></td>
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<tr>
<td><strong>Renewable energy planning, policy and project evaluation and development methodologies</strong></td>
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<tr>
<td><strong>Development of Sustainable Rural Energization Plans (PERS)</strong></td>
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| Sustainable Rural Energization Plans (PERS, for its acronym in Spanish) “A national initiative for regions”. Nationwide coverage. | The Program supported the Government of Colombia (GOC) and regional entities in developing national policies, applied methodologies and Sustainable Rural Energization Plans (PERS) in Nariño, Tolima, Guajira, Cesar, Choco, Cundinamarca and Orinoquia (Meta, Vichada, Arauca and Casanare). Assistance in the formulation of PERS to be implemented after CCEP’s intervention in the departments of Putumayo, Huila and Norte de Santander. | • Technical and financial assistance for the formulation of the PERS methodology.  
• Design, implementation and support in developing survey methodologies, geographic information systems, rural development methodologies and regional policy guidelines in seven PERS. |  
* UPME  
* IPSE  
* Chancellery (Frontiers for Prosperity Plan)  
* Regional institutions (SENA, regional corporations, governorships, universities) | December 2012 | December 2016 |
| SIPERS – Information System for Sustainable Rural Energization Plans, nationwide coverage | CCEP hired a specialized team to design and install the nationwide information system SIPERS, aimed at consolidating and integrating document and geographic databases from all completed Sustainable Rural Energization Plans and including data and results generated by ongoing and future PERS. | • Design and development of a systematic tool to improve decision-making processes, based on PERS information and tools used in UPME’s information systems.  
• Analysis and statistical modelling to find hidden relationships between stored data.  
• Integration with UPME’s information systems. |  
* PERS regional teams  
* UPME  
* Involved national entities | June 2016 | December 2016 |
## 2. CCEP Activities and Main Accomplishments

### TASK 1

**Creating Clean Energy (EE/RE) Enabling Environment**

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| Geographic Information System GIS – CCEP, nationwide coverage | CCEP developed a Geographic Information System to manage geo-referenced information gathered during project implementation – from spatial information collected by fieldwork staff in each rural location to the characterization of energy sources and renewable energy projects – or projects implemented in Colombia during the past 20 years. | Implementation of:  
- RE Geographic Metadata Manager.  
- Visor for RE projects in Colombia.  
- Characterization of energy offer and demand patterns in the non-connected zones.  
- Visor for CCEP RE projects. | * UPME  
* IPSE  
* PERS regional teams  
* Involved national, regional public, and private entities | March 2013 | December 2016 |

### Legal and regulatory developments on RE and EE

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<tr>
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| Assistance in providing methodological insights to update the ZNI tariff resolution, nationwide coverage | CCEP provided technical assistance, renewable energy resource assessments and financial modellings to update the ZNI tariff resolution. Models and results were developed by CCEP’s specialized subcontractor and used by the Power and Gas Regulatory Commission (CREG, for its acronym in Spanish) in the formulation of the Resolution # 004/2014 and its internal financial analyses of tariff requests submitted by energy providers. | Updating databases with solar and wind energy resources and technologies.  
- Estimating the Levelized Cost of Energy (COP$/kWh) for different scenarios.  
- Formulating scenarios and supply alternatives for cost-effective energy options per region.  
- Developing population density scenarios based on current and projected energy demand.  
- Submitting data in interactive and usable formats (GIS layers). | * CREG  
* MME  
* IPSE | August 2013 | January 2014 |
2. CCEP Activities and Main Accomplishments

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| Legal and regulatory development of RE/EE Law 1715, nationwide coverage. | Technical and methodological assistance for the regulatory development of:  
a) Technical regulations for the incorporation of surplus power in distribution networks.  
b) Financial modelling and dissemination of RE/EE tax incentives.  
c) Expansion of electricity coverage in rural connected and non-connected zones.  
d) Technical standards and indicative costs for solar and hybrid systems.  
e) Small-scale self-generation. | Support in designing and/or disseminating:  
• Electricity coverage decree # 1623/2015 issued by MME.  
• Tax incentives decree # 2143/2015 issued by MME.  
• Small-scale self-generation decree Project (in consultation stage).  
• Chapter of Technical Regulations for Electrical Installations (RETIE, for its acronym in Spanish), including technical regulations to supply energy supply through non-conventional sources.  
• Technical standards for Isolated Solar Systems (SSA, for its acronym in Spanish).  
• Prototype project methodology DNP/SGR to determine the eligibility of SSA projects financed through the Royalties System.  
• Guidebook and workshops to disseminate tax incentives created by the RE/EE Law 1715 “Invierta y gane con energia”.  
• Energization plan for the ZNI and integration with the Indicative Electricity Coverage Expansion Plan (PIEC, for its acronym in Spanish). | * MME  
* UPME  
* IPSE  
* National Planning Department (DNP, for its acronym in Spanish) | August 2015 | December 2016 |
| Formulation of the National Energization Plan for the Non-Interconnected Areas PEZNI, nationwide coverage | Energization plan for the non-interconnected areas and integration with the Indicative Electricity Coverage Expansion Plan (PIEC 2017-2022). | As a result of information analyses and methodology application, the Program developed:  
• Energization plan for the non-interconnected areas, establishing a medium term vision to accomplish the | * IPSE  
* UPME  
* MME | December 2014 | December 2016 |
## 2. CCEP Activities and Main Accomplishments

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<tr>
<td>Project profile N° T101-DNR03</td>
<td>Programmatic and methodological assistance in evaluating and monitoring the Indicative Action Plan (PAI, for its acronym in Spanish) 2010 – 2015 of the Program for Rational and Efficient Use of Energy and Other Forms of Non-Conventional Energy (PROURE, for its acronym in Spanish)</td>
<td>- CCEP developed a methodology to determine progress, efficacy and lessons learned from the PAI-PROURE: a proposal with evaluation and impact monitoring tools; and a proposal with a focalized strategy of impact actions, implementation mechanisms and monitoring and evaluation tools for the next PAI-PROURE.</td>
<td>* UPME</td>
<td>July 2013</td>
<td>February 2014</td>
</tr>
<tr>
<td>Project profile N° T101-DNR04</td>
<td>Isolated Solar Systems, nationwide coverage in the non-interconnected zones.</td>
<td>- CCEP restructured management indicators used to monitor impacts, indirect results of PROURE activities and the implementation of activities led by MME. These indicators will be useful in monitoring energization goals and subprograms by sector. - The Program designed an online 35-closed-question survey to measure the opinion on key aspects of the Action Plan.</td>
<td>* MME * DNP * UPME * IPSE</td>
<td>August 2015</td>
<td>August 2016</td>
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### 2. CCEP Activities and Main Accomplishments

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| **National Planning Department, General Royalties System (SGR, for its acronym in Spanish).** | working on a prototype project using solar systems in isolated households.  
- MME and DNP developed and incorporated the prototype Project # 21 “Installation of isolated photovoltaic solar systems in the non-interconnected zones” within the General Royalties System. |                                                                                                            |                                       |            |            |
| **RE/EE demonstration projects**             |                                                                             |                                                                                                            |                                       |            |            |
| Implementation of renewable energy systems  | Implementation of photovoltaic solar and biomass gasification systems in the Bogota Botanical Garden.  
Development and installation of a digital app to generate awareness on the RE solutions installed in the garden by displaying interactive information in the garden’s stations and pathways. | The following systems were implemented:  
- Isolated PV powered water-pumping system.  
- Interconnected PV powered water-pumping system.  
- Interconnected gasification system to provide energy for the garden’s administrative and scientific headquarters.  
- Biomass drying and sieving solar system for gasification.  
- BotanicApp, digital app for interactive tour. | * Bogota Botanical Garden, Jose Celestino Mutis  
* National University of Colombia | January 2014 | November 2016 |
| in the Bogota Botanical Garden, Jose Celestino Mutis |                                                                             |                                                                                                            |                                       |            |            |
| Project profile N° T101-DNR05                 |                                                                             |                                                                                                            |                                       |            |            |
| **DINAMOS**                                  | Development and implementation of RE/EE educational and demonstrative applications in 16 schools.  
- Development of the web tool [www.dinamos.co](http://www.dinamos.co), scripts and educational contents, and telematic support provided by the subcontractor to school teachers.  
- 80 teachers were trained in RE/EE educational contents and demonstrative applications |                                                                                                            | * Alecop  
* Secretariat of Education of Cundinamarca  
Schools:  
* IED Departamental Francisco Jose de Caldas | June 2016 | October 2016 |
| “Schools renewed by energy”, coverage in 8 municipalities, department of Cundinamarca. |                                                                             |                                                                                                            |                                       |            |            |
| Project profile N° T102-Dem01                 |                                                                             |                                                                                                            |                                       |            |            |
### TASK 1

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<tr>
<td>Green Campus Udenar electric bicycle project, Pasto Nariño</td>
<td>PV-grid charging station for 60 electric bicycles in the University of Nariño (Udenar).</td>
<td>- Knowledge transfer from teachers to more than 13,000 students in the 8 municipalities intervened by the project.</td>
<td>* IED San Joaquin * IED de Funza * IED San Gabriel * IED Francisco Julian Olaya * IED Bolivar * IED Domingo Savio * IED General Santander * IED Tecnico Comercial Mariano Ospina Rodriguez * IED Miguel Antonio Caro * IED Miguel Samper * IED Monseñor Abdon Lopez * IED Normal Superior de Gacheta * IED Superior de Ubate * IED Pablo Neruda * IED Puerto Bogota</td>
<td>* University of Nariño</td>
<td>July 2016</td>
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Project profile N° T102-Dem02

Project profile N° T102-Dem03
## TASK 1

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</table>
| Solar air conditioning system, Universidad Pontificia Bolivariana (UPB), Medellín Antioquia | Solar absorption air conditioning system in a 220 m² building, Universidad Pontificia Bolivariana. | CCEP provided technical and financial assistance for the implementation of the following systems:  
- Radiant ceiling system.  
- Tank and cold/hot water pumping system.  
- Indirect evaporative cooling equipment. | *Universidad Pontificia Bolivariana* | July 2016 | December 2016 |
| PV solar demonstrative system connected to the urban grid, Dosquebradas, Risaralda | Technical assistance for the installation of a 12 kWp photovoltaic solar system connected to the local distribution network. | CCEP provided technical assistance for:  
- Environmental diagnosis to construct the baseline.  
- Assessment in the identification of environmental impacts resulting from equipment improvements.  
- Setting up the interconnected solar system.  
- Final project evaluation including tCO2e measurements. | *Energitel*  
*SECO-LCA* | July 2016 | December 2016 |
| Methodology to telemeter RE projects in non-interconnected zones. Departments of Magdalena and Valle del Cauca | Conduct studies to implement a remote monitoring system for RE systems installed by CCEP in the communities of Palmor - Cienaga Magdalena, Chachajo and Punta Soldado. | CCEP provided technical and financial assistance in developing a study to promote the implementation of a methodology to gather information and monitor performance of the RE solutions installed in three CCEP projects (Palmor, Punta Soldado and Chachajo) | *National University of Colombia* | October 2016 | December 2016 |
## TASK 1

### Creating Clean Energy (EE/RE) Enabling Environment

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Project profile N° T102-Dem06
2.4 TASK 2: EXPANDING ACCESS TO RENEWABLE ENERGY SOURCES IN OFF-GRID AREAS

The lack of modern energy services in Colombia primarily affects rural populations and curtails economic growth and security in vulnerable Afro-Colombian and Indigenous communities in off-grid areas (ZNI). This task was designed to develop innovative, commercially viable, concrete renewable energy projects in isolated territories lacking access to these energy services.

The Colombia Clean Energy Program completed renewable energy projects in 93 communities including different levels of complexity, purposes, target populations, and technologies. CCEP also completed designs for projects that for one cause or another did not mature to completion, including two micro hydropower plants had to be cancelled.

Original criteria taken into account during program formulation was to focus on developing off-grid community or household energy installations, based on (but not limited to):

- Availability of renewable energy resources
- Potential for development of productive uses of electricity
- Ability to attract third party investment (public, private, or community)
- Willingness and ability of communities to operate and maintain systems

In this section we described how CCEP carried out the community and project pre-selection process and CCEP’s participatory community based renewable energy project development methodology to ensure sustainability. Specific examples of CCEP’s off-grid projects are also highlighted and in many cases they could be categorized under more than one work stream as they reflect the progressive development steps from project identification, formulation, community development, capacity building, implementation, construction, and monitoring and evaluation.

2.4.1 Work stream 2.1 Project identification, implementation and sustainability

Prior to visiting any community, CCEP developed a series of pre-selection criteria based on desk analysis of renewable energy resource distribution, technological options, community organizations and partner identification. It was clear that both a geographic and technical focus was needed to provide the expected impact and results of the program within its life span. Working together with the USAID/Colombia Mission, it was initially decided to develop a first tier of projects in the Pacific region (ranging from Chocó to Nariño), though the Mission also had ongoing initiatives in the Sierra Nevada de Santa Marta which would benefit from the expertise and operational capacity of CCEP.

The first communities selected to visit for renewable energy project development were based on:

- Interest of potential public sector or other partners in co-financing interventions.
- Linking potential renewable energy projects with communities identified by other USAID supported projects such as ACIP (Choco and Cauca); BIOREDD+ (Northern Chocó and Buenaventura); CELI Central (Cauca); CELI North and South (Nariño); previous MIDAS and ADAM project locations in the Pacific corridor-
- Potential to support for productive activities in the community.
2. CCEP Activities and Main Accomplishments

- Focus on biomass and micro hydro or hybrid renewable energy resource assessment, as these are capable of providing “firm energy” for productive activities.
- Solar applications are feasible anywhere in the region though requiring dimensioning larger systems than in other regions, due to the region’s climatic conditions.
- Community organization and willingness of communities to operate and maintain systems.
- Information on rural communities currently not served and technically or economically not feasible to connect to electrical grids within the near future, as assessed on a case-by-case basis.

Using these criteria, CCEP pre-identified 25 communities in Chocó, Buenaventura and Sierra Nevada to initiate fieldwork, the target being to select at least four to work with the first year, using the following methodology.

**CCEP’s Participatory Community based renewable energy project development methodology**

CCEP’s approach to rural renewable energy projects started with and gravitated throughout all phases of project development with the community. Drawing from community participation and organization models from other sectors and programs, including past and existing USAID programs in other fields, CCEP was confident in assuring the “willingness and ability of communities to operate and maintain systems.” But working with communities of any ethnicity or territory takes time, and the pace cannot be imposed by outsiders.

Prior to CCEP, most experiences with renewable energy in off-grid areas in Colombia were implemented by government in a business as usual manner – define a budget, publish tenders, hire a company, implement a physical infrastructure project, and leave. This approach, with little community say or buy-in, led to quite noticeable past failures – expensive “pilot tests” or experiments that proved to be un-replicable and unsustainable, becoming an obstacle to convince skeptical institutions and communities to partner with CCEP to develop renewable energy projects in an unfamiliar community participation approach. In CCEP’s methodology, communities were to participate throughout the whole process, involving project identification and delimitation, social consultation and consensus building, co-sponsorship if not co-finance, social oversight of construction processes and, absolutely indispensable, the management and sustainability of systems installed. CCEP and institutional partners would inevitably leave the communities one day, but the communities stay behind and have to be enabled and empowered to consolidate and further develop the renewable energy solutions provided by outside agencies.

During the first year CCEP developed a methodology for identifying, assessing, formulating and implementing renewable energy projects in off-grid areas. The main steps included in that methodology are illustrated in Figure 9.
2. CCEP Activities and Main Accomplishments

Figure 9 CCEP’s methodology for selecting RE projects

Specifically, at each selected locality CCEP’s field team worked with the community to assess its energy resources and needs for both domestic and productive activities, and carry out social mapping. CCEP then introduced the community to the concept of renewable energy applications (appropriate to those needs), gauged their interest in developing a renewable energy project, and assessed the resources both monetary and human that the community could be able to contribute or access for the project. The contribution that the CCEP incentive fund could allocate to each project was explained in detail, emphasizing that no more than 50% of the total value of the project could be absorbed by USAID resources, and that whichever project was finally designed and decided required a three party alliance: community-USAID-third party (public, private and/or civil stakeholder).

CCEP’s initial site visits and community interaction took from two to five days with two teams (technology and socio-environmental). Having pre-assessed needs and renewable energy resources, initial designs, calculations and alternative project ideas are put down on paper and reports to share with the community and partner institutions. A Power Point presentation, printed on poster board, is taken back to the community to discuss technological options, associated costs, environmental and social consultation requirements, project finance, community roles and responsibilities, timelines, etc. These meetings and follow up discussions lead to Phase 2 indicated in Figure 9—the final engineering designs, economic studies, project designs and budget allocations. During the design phase, generally requiring additional field work, CCEP teams continued visiting and working with the communities to iron out logistical and financial details, to carry out community organization and capacity building, environmental responsibility-building and undertake legal steps: social consultation procedures (applicable to indigenous and Afro-Colombian communities), environmental permits (with final technical designs and blueprints) and administrative organization (organizational charters, legal representation, etc.).

These steps were simplified when dealing with solar systems, but procedures took longer when dealing with biomass-based, wind and micro hydropower plants (MHPs). In fact, in CCEP’s experience
structuring and receiving permits for MHPs took a minimum of two years, while implementation can take much less. Time requirements must be factored in by all potential implementation partners, especially when they face legal time frames like Colombian annual public investment budgets, international cooperation agreements (such as the 5-year time frame for CCEP) or policy-maker pressure (“get it done, fast”).

The time it takes to finalize technical and financial designs does help to consolidate community appropriation of projects, as in Phase 3 they assume an active role in monitoring and reporting on project progress through oversight and operational committees established. In parallel to energy component implementation, when renewable energy technology installations are well underway, complementary productive activities such as preparation of fields for crop irrigation, fishermen’s cooperative organization, ice factories, panela mills, coffee silos, carpentries, computers for schools, etc., can be set up or refurbished in preparation for that moment when communities start receiving the electric service. Communities’ final objective is to have energy for households, productive uses and/or social infrastructure.

During this last phase, an all-important aspect of CCEP’s fieldwork was to train communities in “socio-entrepreneurial” management, operations and maintenance, and financial sustainability of solutions installed, stressing the need for self-sustainability, with no dependence on third-party subsidies. Revenue collection systems, from beneficiary households, productive installations and public infrastructure establishments, have to be set up or reinforced so that community organizations strengthened receive enough income for local operation and maintenance costs, periodic or sporadic external technical maintenance, and spare parts. In particular, solar system users have to assure collection and management of funds for battery replacement and other components after their lifecycles are complete. Though sustainability strategies varied from case to case, where pre-existing community organizations could not take over these functions, CCEP helped them organize a local energy service administration (JASE - Junta Administradora de Servicios Energéticos). These JASES were then charged with operating and managing the renewable energy systems plus whatever other community installations might have been established to generate value added for community production and income for the energy services organization through fees-for-use of the installations.

For this methodology to work, it is critical to establish partnerships, not only with the communities, but with additional institutional backers. In the areas working with vulnerable, displaced, impoverished communities, it is very improbable that they could afford 50% of anticipated project investments, which was CCEP’s initial contractual restriction and general policy for all its activities and projects undertaken. At least one other partner, with capacity to mobilize matching funds, was necessary to complete the alliance community-USAID-third party. As stressed before, forming strong alliances is not just a question of project finance, but a strategic approach to assure buy-in, self-appropriation and socio-institutional follow-up after the intervention is completed and project outsiders leave.

2.4.2 Work stream 2.2: Strategy and outreach plan for cost-share funds

Given the Government of Colombia’s longstanding commitment in advancing energy access to isolated off-grid communities, it was the most interested in associating with USAID/CCEP in identifying and developing projects --- but through normally tedious budgetary procedures and legal and technical prerequisites (such as definitive blueprints and engineering designs, complete environmental permits, etc.). The natural national government partner that CCEP immediately
engaged with was IPSE, with which USAID had already initiated defining an MOU for CCEP. With IPSE, CCEP identified potential projects in Chocó, Guajira and the Sierra Nevada. Another important partner, with which CCEP structured projects in Chocó and Sierra Nevada was the presidential agency DPS. At the regional level, CCEP found a strong ally in the environmental authority in the department of Valle del Cauca, CVC, with which the program developed a portfolio of projects for indigenous and Afro-Colombian communities. Gradually, governorships and other public regional institutions participated in these efforts.

The challenge to involve the private sector in concrete projects was actually achieved in the first rural project implemented, before government partners could finalize their requirements to co-finance other potential projects identified. Though this project was on a small scale, to refurbish an MHP that already existed and in partnership with the sponsors of a Kogui boarding school in the Sierra Nevada de Santa Marta, it helped CCEP refine its methodological approach and provided the team with an opportunity to address one of the acute rural energy challenges: reducing deforestation pressure due to daily demand of fuel wood for boiling water and cooking (2 m³/day). CCEP introduced an efficient cook stove for the boarding school and eliminated the fuel wood required 6 hours a day for boiling water with an electrical water filter powered by the MHP.

With the same logic, CCEP worked to engage power, mining and other companies with a corporate social responsibility or other particular stake in one or other ZNI community or region in identifying possibilities of joint ventures with CCEP. This was the case of Fundación Cerrejón Guajira Indígena, with which CCEP partnered on two projects covering more than 40 Wayúu communities. It was only as time went by, and Law 1715 was passed, that energy companies started to perceive endeavors undertaken with CCEP for those reasons as their own pilot projects to familiarize themselves with alternative renewable energy technologies and implementation strategies in ZNI communities. This was particularly the case of EPM and CELSIA/EPST.

2.4.3 Work stream 2.3 Cost analysis of renewable and hybrid options

Completed Hybrid solar/diesel power system in Punta Soldado in Valle del Cauca. CCEP in in alliance with the Empresa de Energía del Pacífico SA (EPST) implemented this project which is the first of its kind in Colombia, supported by the private sector. EPST, one of the country’s largest electricity companies, approached CCEP in 2013 to work together identifying, structuring, and implementing renewable energy solutions for communities in its area of influence, specifically Punta Soldado. Progress in the formulation and roll out of renewable energy options were slow due to lack of experience and hesitance by the company to finance this type of “costly” installation (compared to more familiar and profitable urban installations). During the course of site visits, community discussions and project design, however, RE/EE Law 1715 was passed in 2014 and stimulated national interest in the installation of hybrid energy systems in ZNI. Despite exceeding conventional cost thresholds per residential installation which had made the company hesitate to co-finance the project, the Law 1715 motivated EPST and corporate owner CELSIA to develop and install a hybrid solar/diesel system for Punta Soldado (a community of 114 households and several institutional and commercial establishments) as
a pilot project. CCEP and EPSA agreed to carry out complementary work: this project included the installation of pre-paid meters, funded by EPSA, to help reduce long-standing debt and encourage greater energy efficiency and rational use of energy, and enable EPSA and CELSIA to remotely monitor each client’s consumption patterns as called for by recent regulations for the ZNI derived from Law 1715/2014. For CCEP, the opportunity to involve a major player in the electricity market in this type of project was also strategic, not only to assure technical backing for the operation of the hybrid and solar systems in the future, but as part of its renewable energy institutionalization efforts.

CCEP and EPSA had complementary responsibilities in project implementation: construction of civil works, household electric installations, installation of PV systems and public lighting, replacement of traditional light bulbs for LED and installation of pre-paid meters. The diesel-power generator to complement PV power was paid for by EPSA, due to CCEP funding restrictions. The project also included training on good environmental practices and a strong socio economic component to consolidate the existing JASE, provide energy efficiency training, and hybrid PV/diesel system operation and maintenance. Work began in October 2015 and was completed in July 2016. The private hybrid power project, first of its kind in the country, was inaugurated in July 2016. CCEP produced a video with community testimonies telling their experience (available in USAID’s YouTube channel) and a series of photographs showcasing the impact of the project in community life. Additional information is presented in Table 5.

**Designed and built 20 kW MHP and associated distribution lines for productive uses of energy for indigenous Embera community at El Yucal, Choco.** CCEP undertook its Phase 1 studies in the community in October 2012 and contacted Climate Alliance to seek matching funds. The NGO had retired from Colombia and could not participate, so in parallel to the engineering designs, environmental studies and permit applications, and formal “consulta previa” held in 2013, CCEP sought other partners. The environmental permit for water usage was also issued by CODECHOCÓ in December 2013. Though IPSE was already involved in the Arusí project, it allocated resources to partner with CCEP and the community in developing the project. In early 2014, an impasse occurred with the forest management plan – the land which the indigenous community had purchased in the 1980’s, prior to the 1991 constitution, had been delimited in the aftermath of the constitution as Afro-Colombian, pertaining to the Riscales Council, not the Panguí indigenous reservation. Though the two ethnic groups respect their de facto boundaries, it took months to be able to solve the legal impasse, with the cooperation of Riscales, and obtain the final permit necessary to proceed with the tender process.

El Yucal is a close-knit, well organized indigenous community of 472 Embera Dóbida, which literally means “corn people”. Every family is assigned 10 hectares to cultivate rice, corn and other staples. Prior to CCEP, the community had received technical assistance in agricultural production from the Climate Alliance, an international NGO. During that intervention, a prefeasibility study was conducted on the possibility of constructing an MHP close to the village.
2. CCEP Activities and Main Accomplishments

The project conceived and agreed with the population included a 20 kW MHP, the distribution grid, internal domestic networks, street lighting, school electrification and the installation of a rice mill, corn sheller and carpentry to provide value added to their produce and a source of income to its JASE, in charge of the technical and administrative operations. CCEP developed business and community strengthening activities focused on project sustainability. Financial sustainability is guaranteed with the proceeds of the rice/corn mill productive project, which accounts for about 50% of JASE income, the other half coming from monthly fees collection. Operational sustainability is assured with local capacity trained to operate and maintain equipment and facilities. In total, the community received about 4,500 person-hours of training. Community participation and ownership, which is critical for project success, has been proficient with continual participation of Río Panguí community.

The main construction contract was issued in December 2014. The MHP was finalized in September, 2015. CCEP and IPSE officially inaugurated and transferred to the community in November 2015. The milling components finalized in December 2015, though technical assistance to farmers ran through mid-2016 to assure that the first cycle of rice milling had been completed. Additional information is presented in Table 5.

**Designed and initiated construction of MHP in Indigenous community in Sabana de Crespo, Valledupar, Cesar.** The idea was that the 18 kW MHP would be interconnected to form a hybrid RE system with the 12 kW solar system recently installed by the Solar Electric Light Fund (SELF) under a separate USAID project in this community. CCEP planned to build an 18 kW MHP – and initiated construction – to provide energy for the health clinic, the school, the community meeting hall, and community stores located in the town. Project long-term sustainability contemplated strengthening the indigenous IPS to operate, manage and maintain the MHP, training on energy efficiency practices to the institution, the indigenous reserve and community members. Wintikua and the indigenous cabildo would be responsible for long-term management and operation of the energy solution provided by the program.

This indigenous community “Arhuaca” de Sabana de Crespo located in Sierra Nevada de Santa Marta is made up of more than seven thousand people, of which over 4,000 have received health services from the clinic run by the Arhuaco health provider (instituto prestador de salud – IPS) Wintikua for several years. Basic public services are scarce: the community does not have access to energy, aqueduct, sanitation, nor water treatment.

During the course of FY2016, CCEP pulled-out from Sabana de Crespo due to unsurmountable differences amongst indigenous authorities and laymen in favor and opposing the project. Project cancellation represented a big blow for CCEP -- four years of work were lost and Incentive Fund projections and program indicator targets had to be adjusted accordingly.
2. **CCEP Activities and Main Accomplishments**

Furthermore, CCEP had to deal with the issue of disposing of construction materials, pipes, and the turbine and generator designed and purchased for Sabana de Crespo. Since MHPs are custom-made, based on specific characteristics of the water source (flow, head, volume), CCEP had to search for alternative sites fitting the power needs and physical requirements of this particular MHP in several departments (Guajira, Magdalena, Cesar and Cauca). Based on a 2013 identification study carried out by CCEP at the request of IPSE and ElectroPalmor, the Program identified a population with similar characteristics, located close to Palmor. Given that CCEP no longer had the time needed to carry out a new MHP, the Program approached several local and regional authorities to inquire about the possibility of building a MHP in Siberia and received commitments to implement the project in 2017 from the Municipality of Ciénaga, the Fundación ProSierra, ElectroPalmor and the Local Community Action Board (Junta de Acción Comunal - JAC) of Siberia. As a result, CCEP contracted technical and topographical studies to design the civil works and electric components required for the construction. Studies and materials will be donated to ElectroPalmor, which along with local authorities, the NGO ProSierra (which has a station near Siberia) and community-based institution will lead the MHP construction post-CCEP.

**Installed new 150 kW turbine and refurbish an old 125 kW MHP to cover increasing energy demand at Palmor, Magdalena.** Palmor is a town in the Sierra Nevada de Santa Marta with about 2,000 inhabitants and 420 subscribers connected to its community-owned and operated MHP micro-grid, the only one known in Colombia. ElectroPalmor is the name of the community-based rural energy service provider. This project was developed in partnership with IPSE. In late 2011, IPSE received an application from Electropalmor to finance a second phase of the MHP through the MME’s rural energy fund FAZNI, given that the town had grown from 105 to 420 homes and commercial establishments since it was designed in the 1980s. While insufficiently formulated and presented for FAZNI, IPSE saw in the substance of the proposal a valid project idea and visited the community in mid-2012. After that visit, IPSE invited CCEP to join resources to undertake the expansion plan, and a scouting visit was organized for November 2012.

The project was inaugurated in October 2016; USAID, CCEP, MME, and IPSE representatives participated in the event, along with ElectroPalmor staff and attendants from Cienaga Mayor's Office. CCEP sponsored a hands-on training sessions on the software for ElectroPalmor staff to improve software use and operations, thus addressing poor management and accounting practices and lack of training on the public utilities' software.
2. CCEP Activities and Main Accomplishments

Installed PV and mechanically-assisted pumping systems to guarantee access to clean water for Wayuu indigenous communities in La Guajira. CCEP worked with FCGI to install PV and mechanically assisted water-pumping systems in 38 rancherías in three municipalities in La Guajira. This project, directly benefited nearly 2,500 people and similar number of occasional beneficiaries from neighboring communities, and facilitated capacity building at the local level, training project beneficiaries and other interested communities on PV systems and mechanical pump operation, maintenance, and repair. CCEP fostered peer-to-peer exchanges by inviting a Nicaraguan expert on mechanically assisted water pumps to visit several locations, interview users, share lessons learned and make recommendations to improve operations. The exchange was followed by a series of workshops and on-site training on pump use, maintenance and repair, offered by the manufacturer.

CCEP witnessed notable spinoffs that resulted from this intervention. First, the project received significant media coverage, attracting attention to sustainable and low-cost solutions for water provision in remote locations by numerous national, local and international organizations working in La Guajira for potential replicability in other communities; second, it offered the opportunity to build alliances with USAID-funded World Food Program interventions in other locations in Colombia; and third, introduced CCEP to the Office of the High Commissioner for Post Conflict, which opened the door to multiple synergies and intense interaction to replicate the “CCEP model” of integral sustainable rural energization.

CCEP designed and installed PV systems for schools in off-grid areas under three separate interventions. In one intervention FCGI contacted CCEP to install PV systems for five indigenous rural education centers (Centro Educativo Indígena Rural - CEIR) in remote locations in La Guajira. The Ministry of Education had recently awarded desk and laptop computers and tablets to several CEIRs in the department to strengthen their educational programs. The schools and administrators approached the Foundation, requesting help to pay for the diesel to power generators but instead they reached out to CCEP seeking more clean energy solutions. The project consists of PV systems to power school computer labs and solar refrigeration systems for school restaurants and benefits more than 2,000 school students and teachers in five boarding schools in the department: Centro Educativo Kasutalain, Centro Educativo Walakari (Media Luna), Centro Educativo Jurura, and Centro Educativo Kamusuchiwo, in Uribia; and Centro Educativo Kasumana in Maicao. Project work started in September and was completed October 2016.
2. CCEP Activities and Main Accomplishments

Under a second intervention CCEP, the Antioquia Governorship and Empresas Públicas de Medellín (EPM) worked to install solar electric power to a Rural Indigenous Educational Center (Centro Educativo Rural Indígena – CERI) in Necoclí, whose buildings had not been completed in time to include in the joint CERI project covering an initial 14 schools in FY2015.

Under a third separate intervention, CCEP installed PV systems at the Siapana boarding school in La Guajira. This work was completed by CCEP in partnership with Cancillería for the Institución Educativa de Siapana/Resguardo Indígena Wayuu and it included PV systems for lighting, computers and refrigeration PV systems for lighting, computers and refrigeration. CCEP’s work also included socioeconomic strengthening regarding energy efficiency training and renewable energy equipment operation and maintenance, and training on good environmental practices.

CCEP designed and Installed PV systems to encourage productive uses of renewable energy by supplying refrigeration needs for a fishing cooperative in Punta Bonita, Buenaventura. CCEP implemented this project for the community council and its fishing co-op, PINPESCA (Asociación de Pescadores y Piangüeras del Río Cajambre), which had previously participated in several USAID programs and received technical assistance and training on sustainable fishing practices and commercial and business aspects. CCEP developed this project to help resolve the community’s and the association’s energy needs by installing PV systems and solar-powered refrigerators guaranteeing the fish cold chain and, thus, improve commercial and income generation opportunities to PINPESCA. The project also included training on operation, maintenance, and repair to PV systems and solar refrigerators, as well as on financial administration and tariff structure (charge per kilogram of fish refrigerated) to assure system sustainability over time. RCN Noticias, the most viewed news show in Colombia, showcased a video note on CE solutions based on CCEP assistance in Punta Bonita on October 12. The video was also included in the RCN Noticias website, available in Clean Energy for Buenaventura.

Installed PV systems in Perijá to provide energy for coffee bean processing equipment. CCEP worked with Cancillería to identify and formulate a project in the Serranía del Perijá in Cesar and La Guajira with the Coffee Growers’ Committee (Comité de Cafeteros de Guajira y Cesar) which was already working with Cancillería to enhance productive infrastructure of small coffee farms in Serranía del Perijá. The project for Perijá involved the installation of 35 small PV systems to provide energy to drive DC motors to power small individual coffee processing equipment and provide basic household electricity for lighting, TV, and cell phone charging. Project beneficiaries were selected among the farmers with coffee bean processing equipment and permanent homes near by the farms so the solar systems would be used throughout the year, not only during 80 days of harvesting.

Cancillería was responsible for the socio economic strengthening, providing additional training on energy efficiency practices and PV system operation, repair, and maintenance and forming a JASE among the 35 beneficiaries, responsible for PV system operation, maintenance, and repair. The JASE received all installations in donation and, in turn, sign an 8-year loan and restitution contract with
2. CCEP Activities and Main Accomplishments

Each individual farmer, assuring monthly service payments and annual quotas to assure sufficient funds for periodic maintenance and opportune replacement of batteries and LEDS lights installed.

**Installed 10 PV systems for other social infrastructure such as remote medical consultations (Telemedicine).** Telemedicina is a GOC program in which communities located in border municipalities have remote access to timely, high quality, and efficient health services via telecommunications. The telemedicine program collaborates with regional hospitals to attend patients and specialists who attend the patients by means of this technology from “reference centers” in Bogotá, Barranquilla, Medellín and other capital cities. However, this is possible only if energy service is constant and sufficient to provide power for medical and telecommunications equipment in remote and isolated places.

CCEP worked with the Colombian Ministry of Foreign Affairs (Ministerio de Asuntos Exteriores - Cancillería) to take this program to ten locations around the country, installing solar refrigerators and PV systems. Project interventions were completed in September 2016.

**Installed PV systems for other social infrastructure such as Public lighting in Vigía del Fuerte (Antioquia) and Bojaya (Choco).** CCEP in partnership with Empresas Públicas de Medellín (EPM) and Antioquia Governor’s Office carried out a portion of a broader project designed to provide solar energy for a water treatment plant, the pumping system for the aqueduct and to install public lighting in both Vigía del Fuerte and Bojayá. CCEP was responsible for all installation activities associated with the public lighting components and for socioeconomic strengthening in all locations.

2.4.4 Work stream 2.3 Capacity building for rural SMEs

This section describes some of the projects that directly included capacity building, but please note that as indicated previously essentially all CCEP off-grid project included a community development and entrepreneurship training that was tailored to the specific conditions and needs of each of the benefited communities.

**CCEP’ Program completed activities focused on community organization, outreach, and education to promote project ownership and long-term sustainability.** CCEP sponsored training session for 14 JASEs in Punta Bonita, Punta Soldado, and Chachajo Buenaventura on business administration; finances and accounting; rational use of energy and energy efficiency; and good practices on energy service provision.

**As part of the Yucal MHP project implementation,** CCEP developed business and community strengthening activities focused on project sustainability. Financial sustainability is guaranteed with the proceeds of the rice/corn mill productive activity, which accounts for about 50% of JASE income, the other half coming from monthly fees collection. Operational sustainability is assured with local capacity trained to operate and maintain equipment and facilities. In total, the community received about 4,500 person-hours of training. Community participation and ownership, which is critical for project success, has been proficient with continual participation of Río Panguí community.

**CCEP also worked with OpEPA to identify and train young environmental leaders, ages 7 - 18, in Punta Bonita, Punta Soldado, and Chachajo on natural resource management, energy efficiency practices, conservation of renewable energy sources, biodiversity, and good environmental practices associated to CCEP interventions in each location.**
<table>
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| **Project identification, implementation and sustainability** | Photovoltaic solar – diesel hybrid system | Supply and installation of a 75 kWp photovoltaic system; household installations, social infrastructure and public lighting; implementation of a prepaid metering system and business strengthening activities for the provision of energy services using a solar-diesel-battery hybrid solution. | The following systems were implemented:  
- 288 PV panels with a capacity of 74,88 kWp.  
- 13 MPPT controllers.  
- 96 battery bank with a net capacity of 9312 ampere hours.  
- Prepaid energy meters, new internal household networks, efficient LED bulbs and power outlets for home appliances.  
- Public lighting (31 LED lamps).  
- Creation of a Local Community Board for Energy Services Management (JASE, for its acronym in Spanish). | * EPSA / CELSIA  
* Community Council of the Afro-Colombian Community in Punta Soldado | October 2015 | August 2016 |
| Solar and mechanical assisted water pumping systems | Solar and biomechanical water pumping systems for Wayuu indigenous communities in La Guajira | Installation of RE water pumping systems for 38 Wayuu indigenous communities, animals and crops, to improve food and nutrition security | The Program installed the following systems for each one of the indigenous "rancherias":  
18 "rancherias" with:  
- 1 photovoltaic solar pump.  
- 1 solar array with 3 to 6 modules.  
- 1 electronic regulator.  
- Storage plastic tanks.  
- PVC hydraulic network.  
- At least 3 faucets to extract water.  
18 "rancherías" with:  
- Pulley, crank. | * 38 Wayuu "rancherias"  
* Fundacion Cerrejon Guajira Indigena | July 2014 | May 2016 |
## 2. CCEP Activities and Main Accomplishments

### TASK 2

**Expanding access to renewable energy sources in currently unserved areas**

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| Micro hydroelectric power plants | Refurbishment and installation of different RE systems for the Kogui ethno-educational center in San Antonio, Dibulla, Magdalena | - Galvanized pipeline structure and PVC suction pipeline.  
- Rope pistoning.  
CCEP also conducted technical training and environmental mitigation activities. | * Secretariado Pastoral Social de Riohacha  
* Kogui ethno-educational center of San Antonio  
* Kogui indigenous communities | November 2012 | June 2013 |
| | Refurbishment of the pico hydroelectric power plant by improving infrastructure, installing an efficient wood stove in the educational center and a water purification system with a sand filter and a UV light disinfection system. | The pico hydroelectric power plant was refurbished by:  
- Improving the extant water intake infrastructure.  
- Installing an electronic regulator.  
The project also installed:  
- An efficient wood stove.  
- A wood plot.  
- Technical assistance for the implementation of a nursery and plot.  
- Water purification system. | | |
| | Refurbishment and expansion of the micro hydroelectric power plant in Palmor, Cienaga, Magdalena | The following equipment were installed:  
- Hydro mechanical equipment, electricity substation and adaptations to the power house.  
- Hydraulic networks between the water intake and the power house, and electricity networks from the power house to the urban zone in Palmor.  
- Internal networks in the urban zone – additional investment by IPSE-.  
- Refurbishment of the old generating unit by repairing the mechanical regulator and electric generator. | * IPSE  
* Electropalmor | November 2014 | October 2016 |
| | Refurbishment and expansion of the micro hydroelectric power plant “Miguel Medina” through the installation of a new generation equipment (150 kW), new electricity networks, repair of the original turbine and business strengthening activities to support the local associative enterprise Electropalmor. | * Secretariado Pastoral Social de Riohacha  
* Kogui ethno-educational center of San Antonio  
* Kogui indigenous communities | | | |
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Expanding access to renewable energy sources in currently unserved areas

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<tr>
<td>Construction of a micro hydroelectric power plant and installation of productive processes in Yucal, Nuqui, Choco</td>
<td>Construction of a micro hydroelectric power plant with electricity distribution networks and strengthening for communal rice and corn mill production and harvesting processes. Installation of a carpentry workshop and strengthening of a socioeconomic organization in charge of managing and operating the project within the indigenous cabildo Rio Pangui, “El Yucal”.</td>
<td>- Social and business strengthening activities to ensure a long-term sustainability and proper usage of project components by community beneficiaries. &lt;br&gt; - The following equipment were implemented: &lt;br&gt;   - Hydro mechanical equipment &lt;br&gt;   - Hydraulic networks &lt;br&gt;   - Low voltage networks &lt;br&gt; - CCEP strengthened the productive systems as follows: &lt;br&gt;   - Delivered machinery and tools for a carpentry workshop &lt;br&gt;   - Supplied machinery and equipment for the rice and corn mill. &lt;br&gt; - The Program also provided socioeconomic strengthening to ensure the project sustainability and proper usage.</td>
<td>* IPSE &lt;br&gt; * Indigenous Cabildo Rio Pangui, “El Yucal”</td>
<td>January 2015</td>
<td>April 2016</td>
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| Studies and designs required for the construction of a micro hydroelectric power plant in Siberia, Cienaga, Magdalena | Studies and designs required for the construction of a 18 kW micro hydroelectric power plant, including the installation of equipment and electricity distribution networks retrieved from the cancelled project in Sabana de Crespo (T201-PN102). | CCEP provided financial assistance to develop the studies and designs required for the construction of the micro hydroelectric power plant with equipment retrieved from the cancelled project in Sabana de Crespo. <br> - Hydroelectric equipment <br> - Pipeline <br> - Accessories for hydraulic conduction | * Electropalmor <br> * Cienaga Mayor’s Office <br> * Fundacion Pro-Sierra <br> * Local Community Board of Siberia | September 2016 | November 2016 |
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| **Photovoltaic Projects**

Renewable energy applications in the Utria National Natural Park, Nuqui, Choco

[Photovoltaic Projects image]

Implementation of PV solar systems for electricity generation and refrigeration facilities in the administrative and tourist installations of the Utria National Natural Park.

The following systems were implemented:
- Photovoltaic solar systems to provide electricity for 3 ecotourism bungalows and one lodge for Unidad de Parques.
- Two photovoltaic solar systems for LED lighting and audiovisual tools for two auditoriums or interpretation centers.
- Two solar refrigeration systems for restaurant facilities.
- Refurbishment of the solar system for the telecommunications infrastructure.

- IPSE
- Parques Nacionales Naturales de Colombia

November 2013 | January 2014

Implementation of RE solutions in the indigenous community of Santa Rosa de Guayacan, Buenaventura, Valle del Cauca

[Photovoltaic Projects image]

Implementation of photovoltaic systems and improved wood stoves in households, the educational center and the crafts workshop in the indigenous reservation.

CCEP implemented the following systems:
- Photovoltaic solar system to provide electricity for the educational center.
- Solar refrigeration system.
- Photovoltaic solar system to provide electricity for the crafts workshop.
- 20 efficient wood stoves for households and 1 efficient wood stove for the educational center.
- Creation of a Local Community Board for Energy Services Management (JASE, for its acronym in Spanish).
- Training for interest groups on good environmental practices.

- Indigenous resguardo of Santa Rosa de Guayacan
- Regional Corporation of Valle del Cauca
- Association of Indigenous Cabildos of Valle del Cauca (ACIVA, for its acronym in Spanish)

April 2014 | October 2014
## 2. CCEP Activities and Main Accomplishments

### TASK 2

**Expanding access to renewable energy sources in currently unserved areas**

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| Energization of isolated Regional Indigenous Education Centers (CERIs, for its acronym in Spanish) in Antioquia. | Implementation of PV solar systems for electricity generation and refrigeration facilities in 14 CERIs in Antioquia. | - CCEP installed 14 PV solar systems – panels, regulators, batteries and inverters- in each one of the educational centers.  
- CCEP developed a social sustainability and community strengthening strategy.  
- Training for interest groups on good environmental practices. | * Governorship of Antioquia  
* EPM, Educational centers:  
- Andabu  
- Valle de Perdidas  
- Majore  
- Nendo  
- Guapa Alto  
- Ule  
- Pablo Muera  
- La Po  
- Bedo  
- Mungudo el Silencio  
- La Primavera  
* Porroso  
* Sabaleta  
* San Miguel | October 2014 | February 2015 |
| Solar cold chain in fish conservation facilities for the fishing association Pimpesca, Buenaventura, Valle del Cauca | Installation of PV systems for fish refrigeration in the fishing association Pimpesca, Punta Bonita, Community Council of Rio Cajambre. | CCEP provided technical and financial support for the installation of the following cold chain:  
- Isolated 7.8 Kw photovoltaic system, integrated by 32 (245Wp) panels.  
- 36 batteries.  
- 10 refrigerators / solar freezers.  
- LED lighting and electricity service for Pimpesca's administrative offices.  
- Implementation of measures to comply with the environmental management plan. Creation of an EcoClub with the participation of children, teachers and community leaders.  
- Training on preventive and corrective system maintenance. | * Fishing association Pimpesca  
* Community Council of the Afro-Colombian Community of Rio Cajambre | February 2015 | December 2015 |
<table>
<thead>
<tr>
<th>Project</th>
<th>Description</th>
<th>Main Components</th>
<th>Partners</th>
<th>Start Date</th>
<th>End Date</th>
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</thead>
</table>
| Photovoltaic systems for the community of Chachajo, Buenaventura, Valle del Cauca | Implementation of photovoltaic systems for households, school, Family Welfare facilities, community household and public lighting in the indigenous reservation of Chachajo. | CCEP implemented the following systems for households and the children’s home:  
- 42 PV solar systems were installed in households and the children’s home, including: solar panel, battery, regulator, electricity network and LED lighting points.  
- 14 panels with inverters to connect electricity equipment to AC current were installed in the school, the educational center and the town’s meeting house. Internal networks for LED lighting were also installed in these locations.  
- For public lighting, 15 LED illumination points were installed, plus 2 PV solar panels with 12 hour autonomy and automatic switching conditions.  
| Photovoltaic systems for the educational institution Bunkwimake, Sierra Nevada de Santa Marta, Magdalena | Installation of photovoltaic systems for the educational institution Bunkwimake, in the Arhuaco indigenous reservation, Sierra Nevada de Santa Marta. | CCEP implemented the following systems:  
Girls’ dorm and toilets:  
- One PV solar system in DC lighting for 8 LED lamps.  
Boys’ dorm and toilets:  
- One PV solar system in DC lighting for 8 LED lamps.  
School restaurant:  
- One PV solar system in DC lighting for 8 LED lamps.  
Single-family households:  
- 220 (2.5 Wp) pico lamps | * Ethnoeducational Institution Bunkwimake  
* Arhuaco Indigenous Reservation of Sierra Nevada de Santa Marta | February 2016 | September 2016 |
## TASK 2

### Expanding access to renewable energy sources in currently unserved areas

<table>
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<tr>
<th>Project</th>
<th>Description</th>
<th>Main Components</th>
<th>Partners</th>
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</table>
| Installation of photovoltaic systems and tele-medicine equipment in off-grid health care centers in the departments of Nariño, Amazonas, Putumayo, La Guajira, Vichada and Vaupés | Support in the implementation of PV solar systems to provide basic health care services through tele-medicine equipment for clinical diagnoses and specialized medical counseling from national health care centers to off-grid health posts. – Tele-medicine program. | The Project implemented:  
- 10 photovoltaic systems – panels, batteries and regulators – with 3 days of autonomy.  
- 6 (55 liter) vaccine refrigerators.  
- 10 pure wave (1,400 watts) inverters to provide energy for 40 double power outlets.  
- 60 (18w) LED tubes.  
- Training for interest groups on good environmental practices. | * Ministry of Foreign Affairs (Frontiers for Prosperity Plan)  
* Divino Niño Health Center  
* Hospital “San Rafael de Leticia”  
* Hospital “Maria Angelines de Puerto Leguízamo”  
* Hospital “Santa Teresa de Jesus de Avila de Dibulla”  
* U. B. A Nuestra Señora del Carmen ESE Cumaribo  
* Hospital “San Antonio Mitu” | February 2016 | December 2016 |
| RE applications in the municipalities of Vigia del Fuerte, Antioquia, Bojaya and Necocli, Choco | Implementation of photovoltaic systems to supply energy for the water purification plant, pumping system for the sewage system and public lighting in Vigia del Fuerte, energization for a Regional Indigenous Education Center in Necocli (Antioquia) and public lighting in Bojaya (Choco). | The following systems were implemented:  
Public lighting including: LED lamp, 2 solar panels, 2 batteries and 1 photovoltaic regulator:  
135 points supplied with PV solar energy to be distributed in the communities of Vigia del Fuerte and Bellavista, Bojaya.  
PTAR and EBAR pumping stations:  
2 interconnected PV solar systems in the community of Vigia del Fuerte to partially cover the electricity required by the PTAR and EBAR pumping stations.  
CERI Necocli  
9 kWp photovoltaic system | * Governorship of Antioquia  
* EPM  
* Empresa Municipal de Servicios Publicos Domiciliarios de Vigia del Fuerte  
* Compañía de Servicios Públicos Domiciliarios de Bojayá | February 2016 | September 2016 |
2. CCEP Activities and Main Accomplishments

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<th>Expanding access to renewable energy sources in currently unserved areas</th>
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</thead>
<tbody>
<tr>
<td>Project</td>
<td>Description</td>
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<tr>
<td>Photovoltaic systems for coffee processing and household installations in coffee growing farms in Serrania del Perija, municipalities of Villa Nueva and Urumita, La Guajira</td>
<td>Implementation of PV solar systems to improve productive infrastructure and household installations for coffee growers in Serrania del Perija.</td>
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**Expanding access to renewable energy sources in currently unserved areas**

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<th>Project Description</th>
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<th>End Date</th>
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</thead>
</table>
| Photovoltaic systems for the indigenous boarding school Siapana, Serrania de La Macuira, Uriiba, La Guajira | The project implemented:  
- Solar refrigerators and freezers to improve food conservation conditions.  
- Photovoltaic solar system to provide energy for 20 laptops in the computer room.  
- Photovoltaic solar system to provide energy for 20 LED lamps, audiovisual and sound equipment in the auditory.  
- Training for interest groups on good environmental practices. | * Ministry of Foreign Affairs (Frontiers for Prosperity Plan)  
* Social Investment Fund (FIS, for its acronym in Spanish)  
* Rural Integral Ethnoeducational Institution Siapana | March 2016 | September 2016 |
| Photovoltaic and solar refrigeration systems in Rural Indigenous Ethnoeducational Centers (CEIR, for its acronym in Spanish) in the municipalities of Uriiba and Maicao, La Guajira. | CCEP implemented the following systems in 5 CEIRs:  
Computer room  
- Photovoltaic solar system - panels, batteries, inverters and LED bulb lamps.  
School canteen  
- Photovoltaic solar system - panels, batteries, inverters and LED bulb lamps, and refrigerator and freezer for the school canteen.  
- Training on good environmental practices, energy efficiency, operation and maintenance of PV systems. | * Fundacion Cerrejon Guajira Indigena  
* Rural Indigenous Ethnoeducational Center Jurura  
* Rural Indigenous Ethnoeducational Center Numero Uno Rural School Kasumana  
* Rural Indigenous Ethnoeducational Center Kamusushiwo’U  
* Rural Indigenous Ethnoeducational Center Media Luna-Jawou | April 2016 | October 2016 |
## 2. CCEP Activities and Main Accomplishments

### TASK 2
Expanding access to renewable energy sources in currently unserved areas

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<tr>
<th>Project</th>
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<tbody>
<tr>
<td><strong>Cancelled or non-implemented projects</strong></td>
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</tbody>
</table>
| Construction of the micro hydroelectric power plant “Aguas Claritas” for the communities of Arusi, Partado and Termales, South Nuqui, Choco | Construction of a 100 Kw micro hydroelectric power plant, including the installation of electricity distribution networks and improvement of the cold chain in the fishing productive system. | The project included:  
- Construction of a 100 kW micro hydroelectric power plant.  
- Hydro mechanical equipment.  
- Hydraulic networks.  
- Installation of electricity distribution networks.  
- Public lighting, household connections and internal household electricity networks.  
- Implementation of a Single Forest Use Plan.  
- Infrastructure, machinery and equipment for ice production.  
- Social and entrepreneurial strengthening to ensure project sustainability. | * DPS  
* IPSE  
* FONADE  
* Presidency  
* Major Council of Los Riscales | May 2012 | October 2015 (Cancelled) |
| Construction of a micro hydroelectric power plant for the Gun Aruwun indigenous community, Sabana de Crespo, Valledupar, Cesar | Construction of an 18 kW micro hydroelectric power plant, including the installation of electricity distribution networks for the social infrastructure in the urban zone. | The project included:  
- Construction of an 18 kW micro hydroelectric power plant.  
- Hydro mechanical equipment.  
- Hydraulic networks.  
- Installation of electricity distribution networks.  
- Public lighting, household connections and internal household electricity networks.  
- Social and entrepreneurial strengthening to ensure project sustainability. | * Arhuaco de La Sierra indigenous reservation  
* Corpocesar  
* Gun Aruwun indigenous community (Sabana de Crespo)  
* IPS Wintukwa decision | April 2012 | March 2016 (Cancelled) |
### TASK 2

**Expanding access to renewable energy sources in currently unserved areas**

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<tr>
<th>Project</th>
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<th>Start Date</th>
<th>End Date</th>
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</thead>
</table>
| Implementation of photovoltaic systems in the communities of Guadual, Ceibito, La Trojita, San Isidro and La Esperanza, Bajo Calima, Buenaventura, Valle del Cauca | Implementation of photovoltaic systems in 5 dispersed communities in Bajo Calima, municipality of Buenaventura, including single-household and school solutions. | The project included:  
- A PV solar system – 2 panels, 1 regulator and 1 battery- to provide LED lighting for households, a power inverter for TV connections and a low power consumption radio device.  
- A PV solar system for the school –6 panels, 1 regulator, a battery bank and 1 inverter-, to provide energy for laptops, satellite internet, and a DC refrigerator to improve food conservation. The school system may also provide energy for a printer and fans. | EPSA  
* Community Council of Bajo Calima | March 2015 | December 2015 |
| Structuring RE solutions in the department of Valle del Cauca | Design and implementation of RE solutions for households and the social infrastructure to benefit indigenous and Afro-Colombian communities in Valle del Cauca. | The project included:  
- Photovoltaic systems and biomass use in the indigenous reservation of Valledupar.  
- Photovoltaic systems for a school and fish refrigeration facilities in the Afro-Colombian community of Chucheros.  
- Photovoltaic systems for a school and fish refrigeration facilities in the Afro-Colombian community of Puerto España.  
### 2. CCEP Activities and Main Accomplishments

#### TASK 2

**Expanding access to renewable energy sources in currently unserved areas**

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<thead>
<tr>
<th>Project Description</th>
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<th>Start Date</th>
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</table>
| Implementation of generation systems to strengthen panela production and increase access to clean energy sources in the community of Alto San Jorge, Dibulla, La Guajira | The project planned to implement the following systems:  
- Hydroelectric energy solutions.  
- Gasification.  
- Improvement of burners.  
- Refurbishment of the photovoltaic system. | * Dibulla Mayor’s Office  
* Producers Association of Alto San Jorge Asopronal  
* Association “Red Ecoagro” | March 2013 | October 2013 |
| Design and installation of RE systems – micro hydroelectric power plant, gasification system-, to support panela production and increase access to clean energy sources for the population and the town’s school. | | | |
| Implementation of generation systems to strengthen productive activities and increase access to clean energy sources in the Yewrwa community, Pueblo Bello, Cesar | The project planned to implement the following system:  
- Solar system to strengthen coffee production, with the capacity to support the operation of the pulping machine and provide energy for household lighting and TV/radio appliances throughout the year. | * Indigenous Producers Association Seynekun  
* Departmental Committee of Coffee Growers of La Guajira and Cesar | Date of structuring: march 2016 | |
## 2. CCEP Activities and Main Accomplishments

### TASK 2

**Expanding access to renewable energy sources in currently unserved areas**

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<tr>
<th>Project</th>
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</table>
| Implementation of energy generation systems to strengthen productive activities and increase access to clean energy sources in the Arhuaco Windiwa indigenous cabildo, Pueblo Bello, Cesar | Implementation of RE systems – micro hydroelectric power plant and/or PV solar system- to strengthen productive activities and increase access to solar energy sources for the population, the town’s school and health care facilities. | The project planned to implement one of the following systems:  
- Micro hydroelectric power plant for productive processes, the town’s school and health care facilities.  
- Photovoltaic system for computer and health care facilities. | * Tayrona Indigenous Confederation.  
* Arhuaco Windiwa indigenous cabildo | Date of structuring: august 2015 | |
| Implementation of RE generation systems for the community of Villa Fatima, Mitu, Vaupes | Implementation of RE solutions for the boarding school, households, water pumping and social infrastructure in the community of Villa Fatima. | The project planned to install the following systems:  
- PV-powered freezers to improve food conservation in the boarding school of Villa Fatima.  
- PV solar water pumping system to facilitate water extraction for students and teachers.  
- Single-household photovoltaic solar systems to reduce fossil fuel energy consumption.  
- Photovoltaic solar system to improve public lighting by incorporating LED equipment. | * Mayor’s Office of Mitu  
* Governorship of Vaupes | August 2015 | March 2016 |
### TASK 2

**Expanding access to renewable energy sources in currently unserved areas**

<table>
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<tr>
<th>Project Description</th>
<th>Main Components</th>
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<th>End Date</th>
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</thead>
</table>
| Implementation of RE generation systems for the community of Jovi Coqui, Nuqui, Choco | The project planned to implement one of the following systems:  
- Hydroelectric energy solution.  
- Gasification. | * Community Council of Los Riscales  
* IPSE | April 2012 | August 2013 |
| Implementation of RE generation systems for the community of San Antonio de Yurumangui, Buenaventura, Valle del Cauca | The project planned to implement one of the following systems:  
- Hydroelectric energy solution.  
- Photovoltaic solar energy. | * IPSE  
* Community Council of Rio Yurumangui | October 2012 | March 2013 |
| Micro hydroelectric power plant Bunkwimake in Sierra Nevada de Santa Marta | The project included:  
- Construction of a 10 Kw micro hydroelectric power plant.  
- Hydro mechanical equipment.  
* Arhuaco indigenous community  
* DPS | July 2012 | June 2015 |
### 2. CCEP Activities and Main Accomplishments

#### TASK 2

**Expanding access to renewable energy sources in currently unserved areas**

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<tr>
<th>Project</th>
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<tbody>
<tr>
<td></td>
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<td>• Public lighting, household connection and internal electricity networks.</td>
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<td>• Implementation of a Single Forest Use Plan.</td>
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<td></td>
<td></td>
<td>• Infrastructure, machinery and equipment for the carpentry workshop, strengthening sugar cane and cocoa production, and refurbishing the sugar mill.</td>
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<td></td>
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<td>• Social and entrepreneurial strengthening to ensure project sustainability.</td>
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<td></td>
<td></td>
<td>• Creation of a Local Community Board for Energy Services Management (JASE, for its acronym in Spanish).</td>
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**Community organizations capacity building**

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<tr>
<th>Project</th>
<th>Description</th>
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<th>Start Date</th>
<th>End Date</th>
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<tbody>
<tr>
<td></td>
<td>Implementation of micro-financed social entrepreneurship to support the commercialization of solar lamps in rural communities of La Guajira and Magdalena</td>
<td>• Diagnosis of organizational capacities for selected entrepreneurs.</td>
<td>* Iluminando / Brand Solutions project * Fundacion Cerrejon Guajira Indigena</td>
<td>July 2016</td>
<td>December 2016</td>
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<td>• Training on business model, product management, logistics, effective sale, complaint management, development of marketing/promotional pieces and administrative/accounting capacities.</td>
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<td>• Delivery of a marketing kit with the solar lamps to be commercialized – seed capital-</td>
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</table>
### TASK 2

#### Expanding access to renewable energy sources in currently unserved areas

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<th>End Date</th>
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</thead>
</table>
| Technical and business training for 14 JASEs in non-interconnected zones of Valle del Cauca | Technical and business training for the administration, operation and maintenance of energy generation systems for 14 JASEs located in non-interconnected zones. | The project included a theoretical-practical and administrative training process with the participation of 14 JASEs ascribed to and endorsed by the municipality of Buenaventura, covering topics such as:  
- Administrative management.  
- Accounting and financial capacities.  
- Collection tariff.  
- Definition of operation and maintenance costs.  
- Rational use of energy.  
- Technical operation and maintenance of energy generation plants. | * Economic and Rural Development Secretariat of the municipality of Buenaventura  
- JASEs:  
  * San Antonio  
  * Puerto Valencia  
  * Barranco  
  * La Plata  
  * Veneral  
  * La Concepcion  
  * San Pablo  
  * Mayorquin  
  * Joanquinsito  
  * Santa Cruz  
  * Silva  
  * San Isidro  
  * Union de Aguas Claras  
  * Puerto Pizario | September 2016 | November 2016 |
2.5 TASK 3: ENERGY EFFICIENCY AND RENEWABLE ENERGY INVESTMENT PROMOTION

During the course of the period of performance, this task went through the most dynamic evolution since the original conception of the Colombia Clean Energy Program contract. With USAID approval, CCEP management opened and later merged additional work streams, a strategy that paid off as reflected in our final indicators on investment mobilized, renewable energy generation and GHG emissions reduction from the private sector.

This section is organized in three subsections. The first presents the assessment made during the first semester of Program implementation on the industrial subsectors and technologies to target for energy efficiency promotion 2. The conclusions reached on target interventions remained firm throughout the Program, and will be presented in this section.

The second subsection begins with reference to the evolution of our work with target industries regarding EE/RE project development, which started out as a single work stream, grew to six and merged into three final strategies. Third, we present the technical and financial facilitation of selected projects. As in the previous section on Tasks 1 and 2, this section finalizes with a summary table of the Task 3 interventions that came to fruition.

2.5.1 Work stream 3.1 Industrial subsector and/or technology assessment

During the first semester of Program implementation, a multi-criteria methodology was developed to assess which industrial subsectors and/or technologies CCEP should focus its promotion of clean energy technologies on. The first step was to collect secondary statistical data on industrial economic, environmental and social indicators from national sources such as the National Mines and Energy Planning Unit (UPME), National Administrative Statistics Department (DANE), National Industrialists Association (ANDI), Ministry of Environment and Sustainable Development (MADS), among others.

Strictly from the energy and environmental perspective, the challenge found by CCEP can be summarized in two simple graphics (Figure 10 and Figure). Though they refer to the most recent published in UPME’s energy balances, they do not differ much percentagewise from findings at the time. The first demonstrates that 40% of final energy consumption in Colombia originates in the transportation sector, which is a universe of itself and was not part to CCEP’s scope of work. But the second largest consumer sector is industry, with 29% of final energy consumption.

Just how this consumption is distributed by energy source is reported in Figure 10. Two major conclusions can be drawn. First, 62.5% of industrial energy consumption comes from fossil fuels, which emit greenhouse gases and particulate matter. Second, biomass residues from agroindustry are an important and clean fuel already being significantly used: nearly 21%. Just from these two known patterns, CCEP thought it should focus on abating industrial fossil fuel use to reduce CO2 emissions and also on a broad range of agro-industrial residues (renewable energy) as a potential source of fossil fuel substitution. However, this still left the question of which specific subsectors to select.

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2. CCEP Activities and Main Accomplishments

Figure 10 Transportation and industry have lion’s share of Final Energy Consumption

![Pie chart showing energy consumption distribution in Colombia 2015](image1)

Figure 11 GHG emitting fossil fuels dominate industrial energy consumption

![Pie chart showing industrial energy consumption by source 2014](image2)

Using the statistical data collected, a multi-criteria matrix was developed to assess and prioritize industrial subsectors for CCEP project identification and development. Some of the criteria evaluated include participation in the industrial sector energy demand, types and fraction of fuels used, participation in the industrial sector gross product, participation in national greenhouse gas balances and prioritization based on GOC interests, potential of energy production/recovery from biomass, solid waste, liquid waste and waste gases, participation in the industrial sector job generation and geographical location concerning areas of interest of GOC and USAID.
2. CCEP Activities and Main Accomplishments

A weighting system was developed by which variables such as employment generation rank high in social importance, contribution to GDP the subsector’s economic importance and fossil fuel dependency or biomass substitution potential represented environmental importance. This analysis of industrial subsectors highlights the food/beverage/agro-industry, paper and pulp, textile and brick & ceramic subsectors as shown in Figure 12. The main advantages of working with such sectors is the direct impact that projects can have in greenhouse gas emission reductions, especially where fuels such as coal, oil and natural gas are used, and in those sectors with higher replication potential, such as the brick and textile industries which have a very broad range of company sizes and are mostly composed of a large number of small-medium enterprises. Though the paper and pulp and sanitary ceramics sectors also rank high, they are composed of a few large industrial operations and were not prioritized for the first tier of Task 3 activities. However, in time the paper and pulp RE work through the PPF strategy.

For CCEP’S first year work plan, efforts were concentrated in the agroindustry-food and brick production sectors because promotion activities for these had already been realized before the start of CCEP by its task 3 subcontractor and other known initiatives, so some momentum in the promotion of energy efficiency technologies already existed. Also, it was expected that these sectors have greater replication potential due to the larger amount of companies and installations compared to the other assessed subsectors. The textile industry also has a large number of installations and good replication potential, so this subsector was also targeted for a second tier of projects.

Opportunities for renewable energy generation in industry are practically limited to biomass combustion or generation of biogas/syngas for which opportunities may be available mainly within the agricultural and food processing subsector.

Regarding technology assessment, a selection of well-defined technologies that are applicable to a broad range of productive activities was made, based on criteria defined by national authorities (e.g. in PROURE) and technical expertise from CCEP’s work group and management. Though a list of 13 types of technologies was defined, CCEP focused primarily on thermal heat, steam and cogeneration based on fossil fuels or where substitution with biomass fuels could be applicable.

2.5.2 Work stream 3.2 Identification of target industries and project development

The Colombia Clean Energy Program developed six different approaches to motivating industry to invest their own resources in energy efficiency and renewable energy applications. This evolution resulted from continuous contact with and feedback from industry, commercial and second-tier banks, international financial institutions, ESCOS, policymakers and regional environmental authorities with which CCEP interacted during the implementation of Task 3. Project by project are mentioned in Table 10 Task 3 – Summary Project Activity Table – March 2017 at the end of this section, which only describes a few representative projects per portfolio.
2. CCEP Activities and Main Accomplishments

Figure 13 Evolution of Task 3 project portfolios 2012 – 2016

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<td>Case by Case (LCA)</td>
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<td>B</td>
<td>ESCO Projects</td>
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<td>C</td>
<td>Yumbo industrial corridor</td>
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<td>D</td>
<td>Combustion optimization</td>
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<td>E</td>
<td>CAEM brick SME project</td>
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<td>F</td>
<td>Boiler &amp; kiln project</td>
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<td>F</td>
<td>Clean Energy PPF Projects</td>
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a. Case by Case Portfolio

In order to work with the subsectors identified, CCEP formed an initial strategic alliance with Bancolombia’s Environmental Credit Line (LCA for its Spanish acronym), the only active financial credit line available in early 2012. This credit line provided SMEs with the opportunity to get an up to 25% write off of debt incurred by a company for non-mandatory cleaner production investments which effectively curb pollution, paid to the Bank by the Swiss Economic Affairs Ministry (SECO). This mechanism required a baseline energy and emissions analysis and a post-investment energy/environmental performance audit carried out by CCEP’s T3 subcontractor (CNPMLTA, or “Centro”) at beneficiary company’s cost. Since the Centro was now a CCEP subcontractor, companies no longer had to pay fees for the engineering studies, which CCEP provided as technical assistance. In addition, CCEP financed a series of workshops with target industries and bank managers to motivate application to the LCA and technical assistance by CCEP engineers and financial analyst.

During CCEP’s first work plan, at least 30 companies were visited by the Centro under this mechanism, of which 22 qualified for CCEP baseline evaluations but only two projects ended up actually completing the full cycle from project identification through baseline study, design, evaluation, credit application and approval, and implementing clean energy technologies via the LCA credit line: a heat recovery project at Los Cerros brick manufacturer in Cordoba and an efficient refrigeration project at Helados Tonni in Urrao, Antioquia.

First year experience working closely with Bancolombia, receiving feedback from approximately 400 attendees to workshops, visiting numerous industrial plants and holding intense discussions with engineering companies involved and other financial institutions, led CCEP to the conviction that more than the LCA had to be mobilized to reach Task 3 objectives.
2. CCEP Activities and Main Accomplishments

b. ESCO Portfolio

In 2013, a second work stream was developed with Energy Service Companies (ESCOS), which have the technical and financial muscle to design and develop EE/RE projects and invest in their implementation under energy service contracts, freeing companies from needing to channel own resources and credit to these projects. Energy is not the core business for industrial or commercial establishments, and their investment capacity is usually channeled to expanding production or entering new markets – not improving their technologies and competitiveness. In contrast, energy is the core business of ESCOS, and their investment criteria are longer-term than many companies visited, which want quick and high returns on investment in order to undertake clean energy projects. ESCOS are relatively new and not yet well established in the market, but have proven to be successful in mobilizing energy efficient industrial, public sector, and utilities installations in the U.S. and other countries. With ESCOS, over the next two years, CCEP developed engineering and financial studies in agroindustry, ceramics and glass manufacturing, as well as a shopping center and a group of 300 commercial establishments - see Table 10. After 2015, further work with ESCOS was channeled through the PPF portfolio (F).

The photos illustrate the only ESCO contract that was finally closed, signed and implemented from this first batch of the ESCO work stream by 2016: a biogas to steam project at a dairy factory (Colanta in Antioquia). This case is illustrative of the difficulties, and rewards, of the ESCO model and the technological solution implemented at Colanta. Biogas production at the dairy plant varies with weather and other conditions, and before the project was simply flared (photo). The 4-month, US $40,000 study to define and design the technology to make energy use of this biogas was co-financed 50/50 by CCEP and MGM Innova Energy Services, the ESCO company in this case. In March 2014, MGM offered Colanta a contract by which the ESCO would take biogas from its waste water treatment plant (PTAR for the Spanish acronym), clean and transport it to a boiler room, where MGM would install a small low pressure boiler to produce process steam for the dairy factory, substituting about 5% of steam production currently based on natural gas. Negotiations took more than two years, on and off, before they reached agreement on the novel terms of contract. Instead of providing steam for a fixed period of time, the contract reached was for a total amount of steam to be delivered before MGM recovers its investment and Colanta gets to keep the equipment. Depending on biogas production, this could take 6 to 8 years. The price set for the steam is about 85% of what it would cost the plant using natural gas. Once the ESCO contract was signed, it took only 4 months to import equipment, mount and commission the system by the end of 2016, with an additional investment of US $310,000 by MGM – bringing the total operation to $350,000, of which CCEP contributed less than 6% and leveraged the rest. The whole process took the better part of three years. This is part of a learning process from which several benefits have derived. MGM improved its pre-study agreement model with potential clients, developed an alternative performance contract and has begun to bill Colanta for steam. Colanta gained trust in the ESCO model and is exploring additional projects. And the country is left with a proven alternative to flaring biogas applicable at numerous agro-industrial and
food processing plants with insufficient production of biogas to merit cogeneration at competitive costs with market electricity prices.

c. **CVC/CCEP Yumbo Corridor Portfolio**

During 2013, discussions also began with CVC, the regional environmental authority of the department of Valle del Cauca, on how CCEP could contribute to a pressing air quality problem emanating from the industrial corridor in Yumbo, a city contiguous to Cali. This presented CCEP with a carrot-and-stick opportunity that it was willing to explore as well. CCEP assistance in structuring viable pollution-reduction clean energy projects in the plants was the carrot, and the sanction capacity of the environmental authority was the potential stick. In addition, the opportunity to work in a geographic cluster with a strong technical and financial ally and successful industries was also attractive from a CCEP management perspective of efficient use of the Program’s technical and financial resources.

CCEP agreed with CVC to provide technical assistance and financial analysis to design pollution-reducing energy efficiency investment projects for up to 10 of 20 companies to be selected in that industrial cluster over the course of up to two years. Preparatory stages occurred between September and December of 2013, focusing on identifying companies with emissions of at least 100 tCO2e per year based on fossil fuels to be invited to participate. The joint CVC/CCEP program was kicked off in February 2014 and ran through September 2016. Contacts were established with 37 industries. Demonstration of interest was expressed by 24 of them, and all were visited by CCEP engineers. Of these, 5 were discarded as ineligible by CCEP criteria and 2 retired. Energy audits and diagnoses were performed in the remaining 17: Industria Colombiana de Maderas (Inducolma), Diaco S.A., Carvajal Pulpa y Papel, Comestibles Aldor S.A., Cobres de Colombia LTDA, Cables de Energía y Telecomunicaciones S.A. (Centelsa), Cervecería del Valle S.A., Italcol Alimentos Concentrados, Smurfit Kappa Carton de Colombia, Alimentos Finca S.A., Incineradores Industriales S.A., Cartones del Valle, Cajas Colombianas (CajasCol), and MAC Johnson Controls.

In seven, basic or detailed engineering studies were performed by engineering firms hired with counterpart CVC resources, and the Clean Energy Project Structuring Mechanism (PPF) took over work with potential for several specific projects: paper and pulp company Carvajal Pulpa y Papel (better known as PROPAL). The particular projects designed are summarized in the CCEP Project Profile publication, but the overall results were not positive (except for Carvajal). The companies in Yumbo were reluctant to undertake the investments designed to reduce energy consumption and associated emissions in their productive processes. Some of
2. CCEP Activities and Main Accomplishments

them were even eligible for financial incentives from CCEP’s other Portfolios’ mechanisms (A, E or F). A lot of the fuel combustion equipment evaluated, particularly the boilers of some companies, demonstrated serious security problems that should and could be solved with energy-focused interventions to avoid worker accidents.

The above three approaches, case by case project development with the commercial banking sector, ESCO project development with an alternative financing scheme for companies not willing or able to incur in commercial debt or self-financing, and the carrot-and-stick project development with an environmental authority all exhibited slow maturation periods.

There was also the possibility of these approaches not being implemented within the period of performance of the Colombia Clean Energy Program, in time to avoid nearly 500,000 tCO2 emissions and other key objectives pursued. Nonetheless, each promised good potential to actually demonstrate that energy efficiency and emissions abatement in Colombian industry can surpass historic discourse and penetrate into the economy. CCEP decided to persevere in implementation of these work streams, but try additional approaches.

d. Implementation of adequate air–fuel combustion systems for the brick industry

The next approach began with conversations between the Bogotá Chamber of Commerce (CCB) and its affiliate the Business Environmental Corporation (CAEM) with USAID in late 2013, and follow up by CCEP in January 2014. Referred by USAID, CAEM and CCB approached CCEP to assist it in developing a pilot scale energy efficient brick kiln designed by a Colombian researcher in laboratory scale at a Mexican university. CCEP promptly discarded the proposal, as the focus of the program is to implement proven robust technologies with real life impact rather than test ideas, but counter-proposed working with simpler, easily implemented and immediately effective technologies in a larger number of beneficiaries. CCEP was familiar with CAEM’s work with the brick sector throughout the country under Swiss EELA and Inter-American Development Bank OPEN programs, and given its track record came to an agreement on which technologies to promote.

Instead of seeking modifications to kilns, or their replacement, an effective measure to curb coal consumption and emissions would be to pulverize and inject coal into kiln chambers to achieve complete combustion, without intervening the kilns internally at the risk of the SME. The poster and photos show that these technologies are simple, not costly, external equipment that can adapt to the needs of any beehive or Hoffman kiln.

Seizing the opportunity, CAEM developed a proposal for the implementation of a 2-year project to install clean energy solutions and achieve substantial emission reductions in the Colombian brick sector. Under this USD $1.17 million initiative, USAID, CCB and CAEM supported 19 small and medium scaled artisanal brick factories located in the departments of Cundinamarca and
Boyacá, for the replacement of old coal feeding technologies used in brick beehive and Hoffman kilns with modern and combustion optimization equipment to improve feeding and combustion systems for brick kilns, reducing about 30% fossil fuel consumption and corresponding CO2e and particulate matter emissions per year.

The project was implemented in four phases. In a preliminary phase, CCEP and the implementing partner constructed the base line of the project, by gathering data in each production facility to measure production volumes and fossil fuel consumption rates. This phase also focused on collecting information to determine the number of workers and staff to be directly benefited from the solutions installed. The second phase went on to develop negotiation rounds between technology providers and brick manufacturers selected. The third phase involve actual investment and installation of equipment and operator training. The final phase monitored performance and recommended operational adjustments to optimize the use of the technologies installed. The first dosifier was installed at Arcillas de Colombia (Cogua, Cundinamarca) in early 2015, but implementation ran into snags and numerous manufacturers were unable to meet their financial obligations to pay at least 50% of the equipment and had to be substituted along the way. The last dosifiers were installed between July and September of 2016. Some companies were not able to meet the implementation and standardization schedules due to persistent technical and/or operational problems, delaying completion or, in one case, cancelling participation in the program.

All systems installed before April 2016 were monitored and adjusted to fully optimize combustion. After all adjustments, most of the last companies successfully tested their kilns, achieving expected results in greenhouse gas (GHG) emissions reductions, while others only achieved moderate reductions. All field activities in this work stream were completed by FY2016. Table 6 presents final results of SMEs participating in this project: 19 SMEs (out of the 20 originally planned) in Boyacá and Cundinamarca completed the two-year project, installing coal dosifier systems reducing 159,448 metric tons of carbon di-oxide (CO2e) in the next 20 years.

<table>
<thead>
<tr>
<th>Brick Manufacturer</th>
<th>Municipality (Department)</th>
<th>Installed since</th>
<th>CCEP Indicators</th>
<th>GHG emissions, lifetime</th>
<th>GHG emissions, program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arcillas de Colombia</td>
<td>Cogua (Cundinamarca)</td>
<td>FY2015 Q2</td>
<td>19,270</td>
<td>4,061</td>
<td></td>
</tr>
<tr>
<td>El Altar</td>
<td>Ubaté (Cundinamarca)</td>
<td>FY2016 Q1</td>
<td>5,568</td>
<td>717.5</td>
<td></td>
</tr>
<tr>
<td>Zipa</td>
<td>Paipa (Boyacá)</td>
<td>FY2016 Q2</td>
<td>9,972</td>
<td>1254.3</td>
<td></td>
</tr>
<tr>
<td>El Sol</td>
<td>Sogamoso (Boyacá)</td>
<td>FY2016 Q2</td>
<td>6,048</td>
<td>673</td>
<td></td>
</tr>
<tr>
<td>Villa Alfarera</td>
<td>Sogamoso (Boyacá)</td>
<td>FY2016 Q2</td>
<td>7,310</td>
<td>734.9</td>
<td></td>
</tr>
<tr>
<td>La Fe</td>
<td>Nemocón (Cundinamarca)</td>
<td>FY2016 Q2</td>
<td>12,540</td>
<td>1322</td>
<td></td>
</tr>
<tr>
<td>Santo Domingo</td>
<td>Chivata (Boyacá)</td>
<td>FY2016 Q2</td>
<td>1,390</td>
<td>144</td>
<td></td>
</tr>
<tr>
<td>La Toscana</td>
<td>Nemocón (Cundinamarca)</td>
<td>FY2016 Q2</td>
<td>7,248</td>
<td>816.2</td>
<td></td>
</tr>
<tr>
<td>Derivados del Barro</td>
<td>Sachica (Boyacá)</td>
<td>FY2016 Q2</td>
<td>860</td>
<td>230.9</td>
<td></td>
</tr>
</tbody>
</table>
Table 6 indicates that, despite hurdles and delays in implementation, the 19 participating brick manufacturers achieved a reduction potential of approximately 17,753 tons of CO2e per year. The project therefore has had a powerful environmental impact, improving the air quality and living conditions for 120 factory workers and adjacent communities, and raising awareness among the private/public sectors and brick manufacturers about the importance of taking immediate action to mitigate climate impacts caused by inefficient brick production.

e. **Combustion Optimization in Boilers and Kilns Portfolio**

Inspired by the simplified concept behind the CAEM project – that not all EE/RE projects require extensive engineering designs, complex technological investments and sophisticated project finance (bank or ESCO funding), this project focused on the promotion of relatively low-cost, rapid-deployment combustion optimization technologies to quickly reduce fossil fuel consumption in often “old-but-still-durable” coal- or natural gas-fired boilers and kilns.

Energy-use equipment inventories completed in late 2014 under the Incombustion/Corpoema industrial subsector analysis for UPME pointed out the general old age and energy-inefficient performance of industrial boilers and kilns, and their recommendation of priority actions to take against poor performance and high emissions coincide with this portfolio’s approach. Of the six actions recommended to improve energy efficiency, the first is exactly what this portfolio seeks: to optimize combustion through automated electronic control systems. Steam requirements in the textile industry, for example, vary according to type of cloth material, texture, dye and other constantly changing factors, and production lines may have different processes, materials, etc., going on at the same time. Boiler controls are often operated manually and cannot instantaneously adjust to process requirements. Automated electronic control systems can instantaneously adjust fuel/air ratios to varying steam requirements, thus optimizing fuel consumption for complete combustion and
2. CCEP Activities and Main Accomplishments

emissions control, resulting in zero or imperceptible GHG emissions and particulate matter in chimney stacks.

Though this particular portfolio was actually initiated after CAEM’s in the last semester of 2014, in a short time 10 companies had already agreed to participate in the initiative and, if budget allotted sufficed, up to 20 companies could adhere and complete installations by mid-2015, which was the original 12-month cutoff date anticipated for this group of projects. Through this portfolio, CCEP financed the engineering studies involved (up to 30% of total project cost) and the companies themselves financed the cost of equipment acquisition and installation (minimum 70% of total project cost). CCEP also provided technical assistance in identifying equipment manufacturers, costs and baseline and ex-post fuel consumption and emissions measurements to estimate project impacts. Project implementation, baseline indicators and calibration can be completed within only one month of reaching agreement between the beneficiary company, the equipment supplier and CCEP, though for impact assessment it is best to wait a few months while operators adjust to change.

By September 2015, five systems were installed and seven were under varying phases of development in Antioquia, Atlántico and Caldas, and possible projects in Cundinamarca and Valle were under definition. The first five systems installed in textile companies Punto Flex, Crystal, Amtex and Wash, as well as metallurgical company Procables, were completed between June and August, and were expected to contribute 6,849 tCO2 emissions reductions per year during project lifetimes. Given this performance, it was decided to prolong the work stream for another year until mid-2016 and to allocate budget to leverage private company counterpart.

In parallel, CCEP also worked with combustion optimization technologies in brick kilns and drying systems, similar to CAEM’s project but in different territories and with different technology suppliers. The results of this work stream are summarized in the following tables.

<table>
<thead>
<tr>
<th>N°</th>
<th>Beneficiario</th>
<th>Resultados</th>
</tr>
</thead>
</table>
| 1  | Amtex        | • 3.1% savings on average natural gas consumption, corresponding to 3,163.1m3 per month.  
|    |              | • 72.1 tons of CO2 reduced per year. |
## 2. CCEP Activities and Main Accomplishments

<table>
<thead>
<tr>
<th>Nº</th>
<th>Beneficiario</th>
<th>Resultados</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>• Fossil fuel energy reduced per year amounts to 3,743 MWh.</td>
</tr>
</tbody>
</table>
| 2  | CI WASH      | • 21.6% savings in CO2 emissions achieved in the operation of the 1000 BHP boiler.  
• Annual cost savings in coal budgeted at COP $125M.  
• Annual electricity savings estimated at COP $25M.  
• 1,924 tons of CO2 reduced per year. |
| 3  | Crystal      | • 18% savings on average coal consumption, corresponding to approximately 1,364.2 tons per year.  
• 3,274 tons of CO2 reduced per year in the company’s heat generation system (steam + thermal oil).  
• Energy savings of approximately 9,852 kWh per year. |
| 4  | Textiles Punto Flex | • Reduction in coal consumption of 40.4 grams per pound of produced steam, corresponding to 48% savings on average coal consumption – the highest savings percentage in all CCEP boiler projects.  
• Annual cost savings in coal budgeted at COP $37M.  
• 504 tons of CO2 reduced per year.  
• Additional savings caused by reduced electricity consumption in the boiler’s auxiliary equipment, operation and maintenance activities, and ash and waste material disposal are expected. |
| 5  | STOP         | • 30.7% savings on average coal consumption.  
• 473 tons of CO2 avoided per year.  
• Annual cost savings in coal budgeted at COP $35M.  
• Energy savings estimated at 1,423 kWh per year. |
| 6  | Termilenio   | • 30.7% savings on average coal consumption.  
• 1,221 tons of CO2 reduced per year.  
• Increased productivity in the thermofixing process, from 155 to 235 tons of fabric per month.  
• Energy savings estimated at 4,288 kWh per year. |
| 7  | Tintoriente  | • 9% savings on average coal consumption, approximately 331 tons of coal per year.  
• Annual cost savings in coal estimated at COP $63M.  
• 808 tons of CO2 reduced per year.  
• Energy savings estimated at 4,288 kWh per year. |
| 8  | Zusatex      | • 32% savings on average coal consumption, approximately 503 tons per year.  
• 1,266 tons of CO2 avoided per year.  
• Annual cost savings in coal estimated at COP $157M.  
• Energy savings estimated at 1,504 kWh per year. |
| 9  | Proteco      | • 21.2% savings on average coal consumption.  
• 207 tons of CO2 reduced per year.  
• Annual cost savings in coal estimated at COP $17M.  
• Energy savings estimated at 601 kWh per year. |
| 10 | Coltejer     | • 12% savings on average coal consumption in the optimized boiler.  
• 13,555 tons of CO2 reduced per year.  
• Annual cost savings in coal estimated at COP $694M.  
• Estimated energy savings of 12,037 kWh per year. |
### Table 8 Kiln Optimization Results – 11 Projects

<table>
<thead>
<tr>
<th>Nº</th>
<th>Beneficiario</th>
<th>Resultados</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ladrillera Los Laboyos</td>
<td>• 44% savings on average coal consumption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 713 tons of CO2 reduced per year.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fossil fuel energy savings of 21,456,000 kWh per year.</td>
</tr>
<tr>
<td>2</td>
<td>Ladrillera Ambalá</td>
<td>• 41% reduction on average coal consumption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 1,918 tons of CO2 reduced per year due to reduced coal consumption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fossil fuel energy savings of 56,771,400 kWh per year.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Improved workplace environment for 48 employees.</td>
</tr>
<tr>
<td>3</td>
<td>Ladrillera Delta</td>
<td>• 100% coal substitution for coffee husk biomass.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 5,115 tons of CO2 reduced per year.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Energy savings of 153,923 kWh over the project life-time (10 years).</td>
</tr>
<tr>
<td>4</td>
<td>Ladrillera El Diamante</td>
<td>• 30% coal substitution for coffee husk biomass.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 3,058 tons of CO2 avoided per year.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fossil fuel energy savings of 9,204,720 kWh per year.</td>
</tr>
<tr>
<td>5</td>
<td>Ladrillera Arcillas</td>
<td>• 8.7% reduction on average coal consumption, which is significant considering that coffee husk is not currently available for the company.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 380 tons of CO2 reduced per year.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fossil fuel energy savings of 1,143,518 kWh.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 24 improved jobs.</td>
</tr>
<tr>
<td>6</td>
<td>Ladrillera Meléndez</td>
<td>Replacement of stoker coal combustion systems for travelling grill combustion systems.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 20% coal reduction in the brick drying process.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 1,753 tons of CO2 reduced per year due to savings on coal consumption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fossil fuel energy savings of 5,275,200 kWh per year.</td>
</tr>
<tr>
<td>7</td>
<td>Ladrillera Los Cerros</td>
<td>Replacement of carbojet coal combustion systems for state-of-the-art carbojet systems.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Reduction in coal consumption of 3.3kg per ton of finished product.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 604 tons of CO2 reduced per year.</td>
</tr>
<tr>
<td>8</td>
<td>Sugrés</td>
<td>• 17% reduction on average coal consumption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 1,563 tons of CO2 reduced per year.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Energy savings of 47,034 kWh over the project life-time (10 years).</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Replacement of old carbojet coal combustion equipment for a state-of-the-art carbojet coal-fired system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 13% reduction on average coal consumption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 379 tons of CO2 reduced per year.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Energy savings of 11,405 kWh over the project life-time (10 years).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Coal grinding was eliminated and the 25HP engine required for its operation was completely shut off, achieving additional energy savings.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Brick burning with the new carbojets reduced defective product percentage from 0.8% to 0.3%.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Internal coal transportation from the grinder to the kiln was eliminated. An elevator to feed coal directly from the download location to the carbojet is being installed.</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Heat recovery in a tunnel kiln and use of alternative fuel sources for brick drying to increase production.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 100% coal substitution by heat recovered from the kiln and coffee husk biomass.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 702 tons of CO2 avoided per year.</td>
</tr>
</tbody>
</table>
2. CCEP Activities and Main Accomplishments

<table>
<thead>
<tr>
<th>N°</th>
<th>Beneficiario</th>
<th>Resultados</th>
</tr>
</thead>
</table>
|    |              | - Energy savings of 21,125 kWh over the project life-time (10 years).  
- Brick production was improved in approximately 30% due to a faster drying process.  
- Improvements in the brick drying process reduced defective product percentage from 3% to 0.8%. |
| 11 | Procables    | - 26% reduction on average natural gas consumption.  
- 230,868 m³ of natural gas reduced per year.  
- 885 tons of CO2 reduced per year.  
- Energy savings of 2,277 kWh per year. |

These quantitative results are noteworthy, but so are the qualitative impacts of these interventions on workloads of the operators since the new equipment works more autonomously. The immediate environment is smoke free, particulate matter in surrounding vicinity decreased, etc. Qualitative results and lessons learned are expanded upon in the Project Profile publication. But one is worth noting here before moving on: several brick manufacturers in Medellin and in the coffee zona have successfully substituted mineral coal with biomass (dry coffee husks) in their dosifier equipment, eliminating coal consumption and CO2 emissions altogether. This has proven to be technologically robust and financially attractive, as long as there is sufficient supply of coffee husks in local markets whenever they require it.

f.  
PFP Portfolio

As a policy and financial mechanism to stimulate private sector investment in industrial and commercial clean energy applications, CCEP developed the PPF Clean Energy Project Structuring Mechanism. Operationalizing and implementing it required a dedicated team of engineers and financial analysts, a strong joint UPME/CCEP technical oversight committee and persistent follow up of all activities undertaken in field. Without a dedicated operational unit, the PPF would fizzle as another good intention in the string of good intentions the country has experienced regarding energy efficiency and inter fuel substitution.

Once project proposals were selected for co-financing by UPME or CCEP, the operational unit and CCEP management visited the participating companies and plants and participated in periodic monitoring meetings with the engineering firms hired and company engineers and managers (on-site or by teleconference). In this way, the PPF did not simply finance parts of studies but in technical and financial discussions and developed relations of trust with companies and engineering firms that allowed it to continue following up and accompanying company decision making in pushing forth the investment projects.

The following table summarizes the variety of sectors and projects structured, the total amount of investment structure and some financial and environmental results.
### Table 9 Summary of 17 PPF Projects Structured in 2015-2016

<table>
<thead>
<tr>
<th>Sector</th>
<th>Type of Project</th>
<th>Total Investment Structured (USD)</th>
<th>Total PPF Study Cost (USD)</th>
<th>Internal Rate of Return</th>
<th>Estimated CO₂ emissions reduction (ton CO₂/yr)</th>
<th>% Study Cost / Total Investment structured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food &amp; Beverage</td>
<td>Steam generation from biogas</td>
<td>267,054</td>
<td>10,000</td>
<td>30.45%</td>
<td>1,333</td>
<td>3.74%</td>
</tr>
<tr>
<td>Textile</td>
<td>Convention motor substitution with high efficiency motors</td>
<td>1,460,090</td>
<td>33,333</td>
<td>19.76%</td>
<td>3,714</td>
<td>2.26%</td>
</tr>
<tr>
<td>Commercial</td>
<td>Solar photovoltaic electricity self-generation</td>
<td>439,493</td>
<td>13,333</td>
<td>15.80%</td>
<td>69</td>
<td>3.03%</td>
</tr>
<tr>
<td>Commercial</td>
<td>Solar photovoltaic electricity self-generation</td>
<td>1,328,366</td>
<td>26,000</td>
<td>18.00%</td>
<td>271</td>
<td>1.51%</td>
</tr>
<tr>
<td>Paper &amp; Pulp</td>
<td>Power/steam cogeneration from residual biomass and coal</td>
<td>151,139</td>
<td>83,333</td>
<td>72.30%</td>
<td>16,400</td>
<td>0.55%</td>
</tr>
<tr>
<td>Metallurgy</td>
<td>Heat recovery</td>
<td>156,883</td>
<td>27,859</td>
<td>48.86%</td>
<td>1,000</td>
<td>17.78%</td>
</tr>
<tr>
<td>Metallurgy</td>
<td>Heat recovery</td>
<td>3,027,720</td>
<td>32,779</td>
<td>-</td>
<td>5,000</td>
<td>1.06%</td>
</tr>
<tr>
<td>Paper &amp; Pulp</td>
<td>Boiler combustion optimization with residual biomass substituting coal</td>
<td>1,500,000</td>
<td>85,800</td>
<td>-</td>
<td>42,400</td>
<td>5.72%</td>
</tr>
<tr>
<td>Chemical</td>
<td>Power/steam cogeneration from residual biomass and coal</td>
<td>38,911,190</td>
<td>72,592</td>
<td>15.32%</td>
<td>8</td>
<td>0.19%</td>
</tr>
<tr>
<td>Agronomy</td>
<td>Steam consumption optimization in sugar production process</td>
<td>9,140,000</td>
<td>40,828</td>
<td>163.27%</td>
<td>9,170</td>
<td>0.45%</td>
</tr>
<tr>
<td>Paper &amp; Pulp</td>
<td>Boiler combustion optimization with residual biomass substituting coal</td>
<td>2,500,000</td>
<td>99,400</td>
<td>-</td>
<td>1,200</td>
<td>3.96%</td>
</tr>
<tr>
<td>Paper &amp; Pulp</td>
<td>Optimization and increased evaporation capacity of white pulp</td>
<td>2,500,000</td>
<td>207,100</td>
<td>93.00%</td>
<td>18,100</td>
<td>2.28%</td>
</tr>
<tr>
<td>Agronomy</td>
<td>Power/steam cogeneration from chicken manure</td>
<td>11,417,292</td>
<td>77,646</td>
<td>30.54%</td>
<td>40,600</td>
<td>0.68%</td>
</tr>
<tr>
<td>Agronomy</td>
<td>Power/steam cogeneration from certified Biomass plants</td>
<td>7,110,000</td>
<td>50,771</td>
<td>16.00%</td>
<td>4,250</td>
<td>0.71%</td>
</tr>
<tr>
<td>Forestry</td>
<td>Electricity generation from U.S. certified forest plantations</td>
<td>23,139,171</td>
<td>58,373</td>
<td>7.59%</td>
<td>23,790</td>
<td>0.25%</td>
</tr>
<tr>
<td>Agronomy</td>
<td>Power/steam cogeneration from agroindustrial residues</td>
<td>20,580,000</td>
<td>30,000</td>
<td>61.36%</td>
<td>23,510</td>
<td>0.15%</td>
</tr>
<tr>
<td>Power Sector</td>
<td>2 MW Solar farm in Zulian municipality of Guainia</td>
<td>4,962,591</td>
<td>62,681</td>
<td>36.00%</td>
<td>6,187</td>
<td>1.26%</td>
</tr>
</tbody>
</table>

| Total        | 143,586,959                          | 1,866,731                        | 195,894                   | 6.78%                   |                                              |                                            |

Note: Project 5 was structured in three scales, all feasible. Conservatively, the lowest scale is tabulated, though it is possible that a higher scale will be approved for construction by 2018.
<table>
<thead>
<tr>
<th>Project</th>
<th>Description</th>
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<th>Start Date</th>
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</tr>
</thead>
<tbody>
<tr>
<td>T301-HC01</td>
<td>Technologies to improve combustion systems in the industrial sector</td>
<td>Promote adoption of combustion optimization technologies in boilers and kilns</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Identification of project opportunities and design of energy efficiency projects in the Acopi industrial corridor, Yumbo</td>
<td>CCEP developed the following phases with all the participating industries:</td>
<td>* CVC</td>
<td>February 2014</td>
<td>October 2015</td>
</tr>
<tr>
<td></td>
<td>Providing specialized technical assistance to promote energy efficiency in the industrial sector by encouraging the adoption of optimized combustion systems in boilers and kilns, including the identification of solid biomass or biogas energy generation.</td>
<td>* Identification of industries. * Diagnostic visits. * Evaluation and selection of industries with significant energy efficiency and renewable energy generation potentials.</td>
<td>* Inducolma * Cobres de Colombia * Comestibles Aldor * Carvajal Pulpa y Papel * Diaco * Cerveceria del Valle * Finca S. A. * Centelsa * Smurfit Kappa Carton de Colombia * Italcol * Incineradores Industriales S. A. ESP * MAC Johnson Controls Colombia S. A. S. * Cartones del Valle del Cauca Ltda. * Garcia Rios Constructores S. A. (Rocales &amp; Concretos) * Siderurgica de Occidente. * Momentive Quimica S. A. * Tintuvalle S. A. * Fanalca S. A. * Tecnoquimicas S. A. * Lavanderia Industrial Surteñir S. A. * El Forraje S. A. * Prolatex - Poseto Jeans * Cartones y Plasticos La Dolores * Alumina S. A.</td>
<td></td>
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</table>
### TASK 3

#### Renewable Energy and Energy Efficiency Investment Promotion

<table>
<thead>
<tr>
<th>Project</th>
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<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
</table>
| Implementation of efficient air-combustion systems for the brick industry in the departments of Cundinamarca and Boyaca | Increasing energy efficiency in the brick industry to reduce coal consumption and air pollution per finished unit by installing efficient air-combustion systems and implementing kiln adaptations. | The following technologies were installed in the beneficiary brick industries:  
- 13 carbojet  
- 7 stoker  
- 3 micronizers  
The project also provided training for brick producers on equipment management and maintenance procedures. | * Business Environmental Corporation (CAEM, for its acronym in Spanish)  
* Ladrillera Arcillas de Colombia  
* Ladrillera la Fe  
* Ladrillera la Cascada  
* Ladrillera Santo Domingo  
* Ladrillera el Altar  
* Ladrillera la Toscana  
* Ladrillera el Zipa  
* Ladrillera el Porvenir  
* Ladrillera Derivados del Barro  
* Ladrillera el Sol  
* Ladrillera Emalco  
* Ladrillera Villa Alfarera  
* Ladrillera Gres San Martin  
* Ladrillera Oasis RG  
* Ladrillera Oasis del Camino  
* Ladrillera San Luis  
* Ladrillera Ladirso  
* Ladrillera Cacique G Sol  
* Ladrillera Bella Vista | August 2014 | September 2016 |
2. CCEP Activities and Main Accomplishments

<table>
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<tr>
<th>TASK 3</th>
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<tbody>
<tr>
<td><strong>Project</strong></td>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>Optimization of industrial combustion systems: boiler component, nationwide coverage</td>
<td>Specialized technical assistance for the optimization of industrial boilers through the identification and implementation of systems aimed at improving combustion processes or achieving overall efficiency in boilers.</td>
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</tr>
<tr>
<td>Optimization of industrial combustion systems: kiln component, nationwide coverage</td>
<td>Specialized technical assistance for the optimization of industrial kilns through the identification and implementation of systems aimed at improving combustion processes or achieving overall efficiency in kilns and driers.</td>
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## 2. CCEP Activities and Main Accomplishments

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</tr>
</thead>
<tbody>
<tr>
<td>Consolidate opportunities for private sector investment in clean energy projects</td>
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</tr>
<tr>
<td>Energy efficiency through heat recovery solutions in the company’s Ladrillera Los Cerros and Incineradora Ecofuego, Planeta Rica, Cordoba</td>
<td>Technical feasibility of implementing new technologies to reduce fossil fuel consumption though heat recovery processes.</td>
<td>CCEP provided technical assistance to implement a system that reduced fossil fuel consumption through heat recovery processes.</td>
<td>* Ladrillera los Cerros * Incineradora Ecofuego * SECO-LCA</td>
<td>May 2012</td>
<td>March 2013</td>
</tr>
<tr>
<td>Efficient refrigeration system for an ice-cream Factory in Urrao, Antioquia</td>
<td>Installation of new refrigeration systems with screw type compressors, improved cold chamber isolation and replacement of NH3 refrigerant for R507.</td>
<td>CCEP provided technical assistance for the implementation of an optimized refrigeration system.</td>
<td>* Durango CIA S en C “Helados Tonny” * SECO-LCA</td>
<td>June 2012</td>
<td>January 2013</td>
</tr>
</tbody>
</table>
### 2. CCEP Activities and Main Accomplishments

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<tbody>
<tr>
<td><strong>Project</strong></td>
<td><strong>Description</strong></td>
</tr>
</tbody>
</table>
| Implementation of an automatic combustion system in a wagon type kiln, Ladrillera Santa Rita, Medellin, Antioquia | Technical and financial assistance to Ladrillera Santa Rita to implement an automatic coal injection system. | CCEP provided technical assistance in the installation of 8 stoker units to optimize the burning process. | * Ladrillera Santa Rita  
* SECO-LCA | August 2012 | June 2013 |
| Replacement of the brick kiln in Sugres, Supia, Caldas | Replacement of the manual injection wagon kiln for a more efficient tunnel kiln. | CCEP provided technical assistance in the construction of the new tunnel kiln. | * Ladrillera Sugres S.A.S  
* SECO-LCA | December 2013 | June 2015 |
## 2. CCEP Activities and Main Accomplishments

### TASK 3
**Renewable Energy and Energy Efficiency Investment Promotion**

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<th>End Date</th>
</tr>
</thead>
</table>
| Technical assistance for the implementation of a Hoffman kiln in Amaga, Antioquia | Feasibility and construction of a continuous Hoffman kiln to increase efficiency in the brick burning process, and installation of a low humidity press used in the fabrication of ceramic pieces, aimed at reducing energy consumption in the drying process. | CCEP provided technical assistance for the construction of the new Hoffman kiln and the installation of the press. | * Alfarera Pueblo Viejo  
* SECO-LCA | March 2014 | March 2016 |
| Brick pre-drying and heat recovery systems in Ladrillera Delta, Medellín Antioquia | Adaptation and improvement of brick dryers and recovery of gases produced within the kiln to be used in the drying chamber. | CCEP provided technical assistance in:  
- Adapting and improving brick dryers.  
- Thermal isolation of gas recovery pipelines.  
- Redesign of the gas pipeline for the tunnel kiln.  
- Adaptation of the drying area. | * Ladrillera Delta  
* SECO-LCA | June 2015 | June 2016 |
### 2. CCEP Activities and Main Accomplishments

#### TASK 3

**Renewable Energy and Energy Efficiency Investment Promotion**

<table>
<thead>
<tr>
<th>Project</th>
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</tr>
</thead>
<tbody>
<tr>
<td>ESCOS Projects</td>
<td></td>
</tr>
<tr>
<td>Detailed engineering studies of electric systems in Ceramica Italia, Cucuta, Norte de Santander</td>
<td>Analysis of a study that allows determining energy efficiency and saving potentials in engines, substations and mechanic ventilation systems in Ceramica Italia. Formulation of ESCO proposals to improve these systems.</td>
</tr>
</tbody>
</table>
| CCEP provided technical and financial support to develop the engineering study that includes: | * Gathering and analyzing information.  
* Identification and evaluation of energy saving measures. |

<table>
<thead>
<tr>
<th>Partners</th>
<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>* Garper Energy Solutions</td>
<td>February 2014</td>
<td>June 2014</td>
</tr>
<tr>
<td>* Ceramica Italia</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Detailed engineering studies to replace refrigeration and illumination systems in commercial establishments located in Bogota, Cundinamarca</th>
<th>Development of a study to determine current and potential energy efficiency and saving levels resulting from improvements to the refrigeration and illumination systems in 3,000 commercial establishments.</th>
</tr>
</thead>
</table>
| CCEP provided technical and financial assistance in the characterization of energy patterns in commercial establishments, including: | * Energy assessment of selected establishments.  
* Measurement of energy consumption in refrigeration systems.  
* Construction of the energy consumption baseline.  
* Development of an energy cost matrix.  
* Identification of energy saving potentials and technological upgrading opportunities. |

<table>
<thead>
<tr>
<th>Partners</th>
<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>* Garper Energy Solutions</td>
<td>May 2014</td>
<td>December 2014</td>
</tr>
<tr>
<td>* Fenaltiendas</td>
<td></td>
<td></td>
</tr>
</tbody>
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## 2. CCEP Activities and Main Accomplishments

### TASK 3

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<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
</table>
| Energy efficiency study in Gran Estacion shopping mall, Bogota, Cundinamarca | Identification and project proposal to promote energy efficiency in the mall’s installations. | CCEP provided technical and financial assistance to develop a basic engineering study that includes:  
- Gathering and analyzing information.  
- Identification and evaluation of energy saving measures. | * Garper Energy Solutions  
* Gran Estacion shopping mall. | January 2014 | April 2014 |
| Engineering studies to harness surplus heat in OI-Peldar, Zipaquira, Cundinamarca | Development of basic engineering and investment studies for a surplus heat generation project, which uses an organic rankine cycle (ORC) and the cogeneration of electricity and heat for drying purposes | CCEP provided technical and financial assistance to determine the technical feasibility of the following projects in the Zipaquira plant:  
- Heat recovery through an organic rankine cycle, consisting of 3 integration systems, electricity generation and cooling system.  
- Cogeneration project in the sand drying plant, integrated by: propeller and electric generator, heat recovery systems, refrigeration and auxiliary systems. | * Peldar  
* MGM Innova Energy Services | November 2013 | May 2014 |
2. CCEP Activities and Main Accomplishments

## TASK 3
### Renewable Energy and Energy Efficiency Investment Promotion

<table>
<thead>
<tr>
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<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
</table>
| Engineering studies to harness biogas in the Colanta dairy plant, San Pedro de los Milagros, Antioquia | Study, commercial offer and implementation of a steam generation system for the dairy plant. | CCEP provided technical, financial and commercial assistance for the study and implementation of the biogas harnessing project, developed in two phases:  
- Project feasibility study.  
- Project implementation, in two phases: (compression and biogas purification; and generation and steam transportation). | * Colanta  
* MGM Innova Energy Services | September 2013 | January 2014 |
| Project Preparation Facility (PPF) | Co-finance and develop basic and detailed engineering studies required for technical and financial structuring of RE/EE investment projects. | CCEP’s PPF provided technical and financial support in structuring, evaluating and developing RE/EE investment projects. | Targeted sectors:  
* Agro-industrial  
* Food industry  
* Sugar industry  
* Commercial  
* Forest  
* Large scale surfaces  
* Metallurgy industry  
* Paper and pulp  
* Chemicals  
* Textile | September 2014 | December 2016 |
### 2. CCEP Activities and Main Accomplishments

#### TASK 3

<table>
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<tr>
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<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
</table>
| **Advanced engineering study to harness biogas produced in the residual water treatment plant La Paila, Valle del Cauca** | PPF provided technical and financial support in the advanced engineering study, including:  
- Energy demand in the treatment plant.  
- Analysis of biogas use alternatives.  
- Analysis of alternatives for biogas generation.  
- General scheme for the proposed system.  
- Equipment technical features.  
- Financial analysis and evaluation. | * Colombina  
* MGM Innova Energy Services | December 2014 | August 2015 |

* Project profile N° T30302

<table>
<thead>
<tr>
<th>Project Description</th>
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<th>Partners</th>
<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
</table>
| **Basic engineering study to replace conventional engines by high efficiency engines in two Coltejer plants in Itagüí Rionegro, Antioquia** | PPF provided technical and financial assistance for the basic engineering study, including:  
- Gathering information on electric engines.  
- Measuring energy consumption, voltage and amperage.  
- Determining theoretical savings.  
- Energy consumption savings.  
- Energy costs and CO₂ emissions reduction.  
- Financial evaluation. | * Coltejer S.A.  
* MGM Innova Energy Services | December 2014 | December 2015 |

* Project profile N° T30303
## TASK 3

### Renewable Energy and Energy Efficiency Investment Promotion

<table>
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<th>Start Date</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Basic engineering study for a photovoltaic generation system for the Company Corona, in the departments of Atlantico, Santander, Magdalena, Valledupar and Cesar</td>
<td>PPF provided technical and financial assistance in the basic engineering study, including:</td>
<td>* Tiendas Corona S. A. * MGM Innova Energy Services</td>
<td>December 2014</td>
<td>December 2015</td>
</tr>
</tbody>
</table>
| Structuring and technical/financial feasibility of a generation solar panel system, incorporating a surplus power commercialization model. | - Electric and civil assessments.  
- Advanced engineering (required equipment, capacities, distribution of the photovoltaic field and basic unifilar diagrams).  
- Financial evaluation. | | | |
| Basic engineering study for a photovoltaic generation system in Homecenter stores, located in the departments of Atlantico, Antioquia and Cesar | PPF provided technical and financial assistance in the basic engineering study, including: | * Homecenter * MGM Innova Energy Services | December 2014 | December 2015 |
| Structuring and technical/financial feasibility of a generation solar panel system, incorporating a surplus power commercialization model. | - Electric and civil assessments in stores.  
- Roof characterization.  
- Structural analysis.  
- Photovoltaic system engineering.  
- Financial evaluation. | | | |
### 2. CCEP Activities and Main Accomplishments

#### TASK 3

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<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
</table>
| Detailed engineering for a heat recovery system in thermal treatment kilns for an auto part company in Bogota, Cundinamarca | PPF provided technical and financial assistance in the detailed engineering, including:  
- Energy balance for each one of the kilns.  
- Dimensions of heat recovery systems.  
- Energy saving potential and investment cost.  
- Financial evaluation. | * Imal S. A. | December 2014 | August 2015 |
| Conceptual engineering to harness surplus heat in a steel plant located in Cali, Valle del Cauca | PPF provided technical and financial assistance in the conceptual engineering, including:  
- State-of-the-art and feasible heat recovery alternatives.  
- Gathering information of the process.  
- Fieldwork measurements.  
- Conceptual layouts of feasible solutions.  
| Basic engineering to implement a cogeneration system in the plant Sucroal, Obando, Valle del Cauca | PPF provided technical and financial assistance in the basic engineering, including: | * Sucral | December 2014 | July 2015 |
### 2. CCEP Activities and Main Accomplishments

#### TASK 3
**Renewable Energy and Energy Efficiency Investment Promotion**

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</tr>
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<tbody>
<tr>
<td><img src="image" alt="Perfil de proyecto N° T30309" /></td>
<td>Estimation of operational and maintenance costs.</td>
<td>Estimation of operational and maintenance costs.</td>
<td><em>EPSA</em></td>
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<tr>
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<td>Estimation of investment costs.</td>
<td>Estimation of investment costs.</td>
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<td>Economic evaluation and selection of alternative.</td>
<td>Economic evaluation and selection of alternative.</td>
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</tr>
<tr>
<td></td>
<td>Basic engineering study for a biomass cogeneration system in a sugar mill production plant located in Obando, Valle del Cauca</td>
<td>PPF provided technical and financial assistance in the basic engineering, including:</td>
<td></td>
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<tr>
<td></td>
<td>Technical and financial structuring of a cane bagasse cogeneration system to supply electricity and thermal needs, to increase energy generation in 1.8MW and to export surplus power to the grid.</td>
<td>Energy balance presentation.</td>
<td><em>Trapihe Biobando S. A. S.</em></td>
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<tr>
<td></td>
<td></td>
<td>Operational variables in the boiler and the turbine.</td>
<td><em>EPSA</em></td>
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<td></td>
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<td>Load charts before and after implementing the cogeneration plant.</td>
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<tr>
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<td>Load distribution, foundations and footing design, financial evaluation, investment costs (Capex) and operational costs (opex).</td>
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<tbody>
<tr>
<td>Pre-feasibility and basic engineering study for RE generation with residual forest</td>
<td>CCEP provided technical and financial support in the pre-feasibility and basic engineering phases, including:</td>
<td>* Organización La Primavera S. A</td>
<td>April 2016</td>
<td>September 2016</td>
</tr>
<tr>
<td>biomass to sell surplus power to the grid in the municipality of La Primavera, Vichada</td>
<td>• Analysis of available biomass resources to be used in the generation plant.</td>
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<td>• Analysis of available technological alternatives to optimize RE energy production.</td>
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<tr>
<td></td>
<td>• Verification of available biomass quantities.</td>
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<td></td>
<td>• Calorific value of verified biomass.</td>
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<td>• Calculations required for determining the type and size of the technology to convert biomass in energy.</td>
<td></td>
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<tr>
<td></td>
<td>• Evaluation and financial model.</td>
<td></td>
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<tr>
<td>Analysis of the technical and financial feasibility of a 10MW generation project</td>
<td></td>
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<tr>
<td>using residual biomass to sell surplus power to neighboring municipalities and the national grid. Creation of a biomass commercialization market.</td>
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</tr>
</tbody>
</table>

* Project profile N° T30310

### Engineering study to implement a cogeneration system using bagasse and muds in the Guachene plant, Cauca

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Main Components</th>
<th>Partners</th>
<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical and financial structuring of biomass cogeneration alternatives using bagasse, muds and mineral coal.</td>
<td>CCEP provided technical and financial assistance in the basic engineering, including:</td>
<td>* Carvajal Pulpa y papel * MGM Innova Energy Services</td>
<td>Study</td>
<td>Study</td>
</tr>
<tr>
<td></td>
<td>• Review and verification of mass-energy balance.</td>
<td></td>
<td>December 2014</td>
<td>August 2015</td>
</tr>
<tr>
<td></td>
<td>• Determining the boiler’s efficiency.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Economic analysis of operation with biomass.</td>
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</tr>
</tbody>
</table>

* Project profile N° T30311
### 2. CCEP Activities and Main Accomplishments

#### TASK 3

**Renewable Energy and Energy Efficiency Investment Promotion**

<table>
<thead>
<tr>
<th>Project</th>
<th>Description</th>
<th>Main Components</th>
<th>Partners</th>
<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
</table>
| Conceptual engineering study, commercial offer and implementation of an optimization system for boiler # 5 in the Yumbo plant, Valle del Cauca | Technical/financial feasibility and implementation of a system to partially replace coal by bagasse, mud and steam generation. | - Design capacity of the turbine and the generator.  
- Calculation / review of turbines and steam heads.  
- CCEP provided technical and financial assistance in the conceptual engineering, including:  
  - Identification of boiler limitations.  
  - Definition of short-term operational improvements.  
  - Definition of the amount of coal replaceable by bagasse and mud.  
  - Evaluation of benefits expected from modifying the air system.  
  - Presentation of conceptual modifications and estimated budget. | * Carvajal Pulpa y Papel | March 2015 | May 2015 |
| Operational since July 2015 | | | | | |
| Detailed engineering and implementation of a project to increase black liquor burning in the recovery boiler of Guachene, Cauca | Technical/financial feasibility and implementation of a temperature control system, replacement of trigger nozzles, duct and damper modification in the boiler to increase black liquor burning and steam and electricity generation. | - Analysis of current boiler conditions.  
- Analysis of the opportunities in the new | * Carvajal Pulpa y Papel | April 2016 | August 2016 |
2. CCEP Activities and Main Accomplishments

<table>
<thead>
<tr>
<th>Project profile N° T30311</th>
<th><strong>Task 3</strong></th>
<th><strong>Renewable Energy and Energy Efficiency Investment Promotion</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td><strong>Main Components</strong></td>
<td><strong>Partners</strong></td>
</tr>
</tbody>
</table>
| Detailed engineering study, commercial offer and implementation of an optimization system for the evaporation of black liquor in the Yumbo plant, Valle del Cauca | - temperature control system.  
- Nozzle replacement.  
- Opportunities for the secondary and tertiary air system.  
- Dimensions of equipment and plans.  
- Financial modelling. | CCEP provided technical and financial assistance in the detailed engineering, including:  
- Current evaporating conditions.  
- Opportunity to reduce steam generation.  
- Black liquor evaporation potential.  
- Dimensions of equipment and plans.  
| Technical/financial feasibility and implementation of a system to increase the evaporation of black liquor, and to reduce steam and electricity consumption per finished unit. | - Carvajal Pulpa y Papel * | Under implementation since September 2016 | Operation scheduled for March 2017 |
## 2. CCEP Activities and Main Accomplishments

### TASK 3

**Renewable Energy and Energy Efficiency Investment Promotion**

<table>
<thead>
<tr>
<th>Project</th>
<th>Description</th>
<th>Main Components</th>
<th>Partners</th>
<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
</table>
| Basic engineering study for a cogeneration project using poultry manure. | Technical and financial feasibility to implement a cogeneration system using poultry manure to replace coal and electricity consumption. | CCEP provided technical and financial assistance in the conceptual and basic engineering, including:  
- Gathering information.  
- Zero-case balance – current baseline-.  
- Balance of the best alternative to technological updating.  
- Process diagrams, interconnection lines for each equipment, and plant layouts for selected equipment.  
- Financial modelling, investment costs (Capex) and operation management costs (OPEX) of the selected alternative. | * Pollos el Bucanero | May 2016 | October 2016 |
| Conceptual, basic and detailed engineering studies to reduce steam consumption in the refinery. | Analysis of the technical and financial feasibility for the implementation of different systems to reduce steam consumption and increase electricity generation and processing capacities in the plant. | CCEP provided technical and financial assistance in the conceptual, basic and detailed engineering. The study was conducted in three phases:  
- Gathering information.  
- Selection of a proper matter-energy balance.  
- Plant layout with selected equipment.  
- Financial modelling. | * Ingenio la Cabaña | May 2016 | October 2016 |
## 2. CCEP Activities and Main Accomplishments

### TASK 3

**Renewable Energy and Energy Efficiency Investment Promotion**

<table>
<thead>
<tr>
<th>Project</th>
<th>Description</th>
<th>Main Components</th>
<th>Partners</th>
<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
</table>
| Studies and designs for the photovoltaic solar farm connected to the grid in Puerto Inirida, Vichada | Detailed engineering and financial evaluation to install a 2MW photovoltaic solar farm connected to the distribution network in the rural zone, municipality of Puerto Inirida. | CCEP provided technical and financial assistance in the detailed engineering, including:  
- Gathering information.  
- Initial design – dimension of the photovoltaic solar system, energy production, supporting structures for modules, design of electric installations, substation protection and grounding, required test protocol.  
- Final design – low voltage electric installations, control system, integration of the PV system and diesel generation, substation dimensions and design.  
- Financial modelling, - APU Budget, operation and maintenance costs throughout the project lifespan. | * Gestión Energética S. A. E. S. P - Gensa | September 2016 | December 2016 |

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Project profile N° T30314
3. PROGRAM DELIVERABLES

Under the USAID contract CCEP generated 15 different types of deliverables during the life of the Program. This chapter describes CCEP’s main deliverables under two broad categories: administrative or contractual reports and technical reports. The following sections list and describe the information on these deliverables as listed in the following summary table.

<table>
<thead>
<tr>
<th>Deliverables</th>
<th>General Content / Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contractual</strong> - First year work plan and subsequent years annual plans</td>
<td>The work plan generally included clear and concise language identifying the specific activities to be implemented for each of the contract task areas. The period of the first year work plan was from the contract award date to the end of FY 2013. <em>Status: Completed</em></td>
</tr>
<tr>
<td><strong>Contractual</strong> - Outreach and communications strategy initial year and annual updates</td>
<td>CCEP outreach and communications strategy was part of USAID/Colombia efforts to raise public awareness, understanding and support for USAID/Colombia-funded goals and activities particularly on renewable energy and energy efficiency. The initial strategy was submitted as a standalone document, but it was subsequently submitted along with the annual work plans and revised when needed. <em>Status: Completed</em></td>
</tr>
<tr>
<td><strong>Contractual</strong> - Performance Management Plan (PMP) and subsequent years PMPs</td>
<td>The PMP is a performance management tool for planning, managing and documenting how performance data are collected and used. It included both USAID Standard indicators as well as customized indicators developed specifically for CCEP. It included performance Indicator Reference Sheet describing indicators in detail including definitions, data sources, and frequency of data collection and reporting. In addition, CCEP also developed a GIS system to collect project data and information as part of the technical activities and in support of CCEP’s monitoring and evaluation activities. <em>Status: Completed</em></td>
</tr>
<tr>
<td><strong>Contractual</strong> - Environmental Mitigation or Monitoring Plan (EMMP)</td>
<td>The EMMP or (M&amp;M Plan) is a tool for planning, managing, and documenting describing how environmental compliance is achieved under all conditions that apply to proposed project activities within the scope of the award. The EMMP included monitoring the implementation of the conditions and their effectiveness. The initial EMMP was generated in parallel with the first year plan and it was subsequently integrated within the MONITOR online system as required and instructed by USAID Colombia. <em>Status: Completed</em></td>
</tr>
</tbody>
</table>
## 3. Program Deliverables

<table>
<thead>
<tr>
<th>Deliverables</th>
<th>General Content / Status</th>
</tr>
</thead>
</table>
| **Contractual** - Security Plan       | Security plan / manual created to safeguard all project operations and included security protocols, reporting and emergency procedures.  
                                        | *Status: Completed.*                                                                     |
| **Contractual** - Procurement Plan     | Document generated to carry-out planning and implementation associated with the procurement of supplies and equipment to be used in the activities implemented by the CCEP Project.  
                                        | *Status: Completed.*                                                                     |
| **Contractual** - Grants Manual and Plan| An Incentive Fund was included as part of the contract and was initially limited only to grants. CCEP prepared and delivered the corresponding Grants Manual outlining necessary procedures to issue grants. This Manual was later revised to include more than just grants, such as subcontracts, to provide greater flexibility to encourage participation in renewable energy efficiency initiative.  
                                        | *Status: Completed.*                                                                     |
| **Contractual** - Quarterly reports   | CCEP prepared and submitted to the COR regular quarterly reports on CCEP activities including progress and achievements, performance indicator results against targets, solutions to problems described in previous reports, description of any new problems, plans for following quarter and any success stories.  
                                        | *Status: Completed.*                                                                     |
| **Contractual** - Annual reports      | The annual reports prepared by CCEP described progress made over the course of the year to achieve overall expected results and highlighted results in each of the three Tasks. CCEP reported PMP results which where inputs to USAID/Colombia’s overall PMP and provided relevant analysis of successes and challenges.  
                                        | *Status: Completed.*                                                                     |
| **Contractual** – Project information services | CCEP created and regularly maintained a variety of outreach platforms, including e-mail distribution of newsletters, project update stories for wide distribution on a regular basis with photos and quotes, both in Spanish and in English, and a project web site available to the public. CCEP also created and disseminated other forms of media, such as videos to capture project impacts.  
                                        | *Status: Completed.*                                                                     |
| **Contractual** – Financial Reports. Two types of financial reports were prepared over the contract period:  
  • Accrual Report prepared each quarter  
  • Quarterly Financial Status Report | Accrual report covering period through the end of the reporting quarter  
                                        | Quarterly Calendar Year Financial Status Report |

Final Report, Colombia Clean Energy Program | Tetra Tech Inc. - 93
3. Program Deliverables

<table>
<thead>
<tr>
<th>Deliverables</th>
<th>General Content / Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contractual</strong> - Success Stories</td>
<td>CCEP submitted success stories regarding the impact of implemented activities on beneficiaries and their activities. All success stories were accompanied by photographs of the activities described.</td>
</tr>
<tr>
<td><strong>Contractual</strong> - Final report</td>
<td>This report discusses all activities and achievements of the contract tasks from the start of the project through its completion. This document includes: a summary of the accomplishments, giving the final tangible results; summary of deliverables/benchmarks; lessons learned during implementation and suggested ways to resolve constraints identified; and financial report indicating how funds were expended by line item. <em>Status: Drafted</em></td>
</tr>
<tr>
<td><strong>Technical</strong> – Reports, data and information on Task 1 activities</td>
<td>Documents generated as part of CCEP’s technical assistance, capacity building, and promotion of an enabling environment to promoting RE and EE. <em>Status: Completed.</em></td>
</tr>
<tr>
<td><strong>Technical</strong> – Reports, data and information on Task 2 activities</td>
<td>Documents generated as part of CCEP’s technical assistance, RE project development, capacity building. <em>Status: Completed.</em></td>
</tr>
<tr>
<td><strong>Technical</strong> – Reports, data and information on Task 3 activities</td>
<td>Documents generated as part of CCEP’s technical assistance, EE project development, capacity building. <em>Status: Completed.</em></td>
</tr>
</tbody>
</table>

### 3.1 ADMINISTRATIVE REPORTS

#### 3.1.1 Annual Work Plans

CCEP prepared and delivered four annual work plans over its period of performance. CCEP’s annual work plans outlined anticipated activities for the 12 months of the following fiscal year (except the first year annual work plan which covered the period from the contract award date to the end of FY 2013 and the last annual work plan, which originally presented activities the 12-month period between October 2015 and September 2016, and was later amended upon contract extension to include the six months from October 2016 to March 2017).

The work plans set the path and goals for a “results-driven” approach to implement the scope of work. Broadly speaking, these work plans presented for each of the three main tasks:

- Overall approach
- Planned activities under each subtask
- Strategic and operational adjustments
- Expected time line

The plans were structured to correspond to CCEP’s contract’s scope of work, deliverables, and institutional arrangements with USAID, GOI counterparts, and key implementation partners and
3. Program Deliverables

stakeholders. In all cases a draft report was generated for USAID review and a final version was generated addressing USAID comments.

### 3.1.2 Outreach and communications strategy

CCEP prepared and updated the communication strategy on an annual basis. The initial outreach and communications strategy was submitted as a standalone document in 2012, but it was subsequently submitted along with the annual work plans and revised when needed.

CCEP contributed to USAID’s broader outreach and communications efforts essentially on two dimensions. The first dimension was the outreach or external communications to domestic audiences with the purpose of disseminating information about CCEP’s objectives and activities with a particular focus on potential benefits for co-sponsoring public and private organizations at national or regional levels and benefits to individuals and communities at municipal levels. Also under this first dimension, was the dissemination of specific RE and EE projects, focused on clearly documenting the benefits and impact of those projects. In this context, CCEP prepared and shared with USAID fact sheets and success stories in various formats (print and video) describing the impact of the program, especially at the community and individual levels. CCEP also coordinated with the COR and USAID’s Information and Communication office to provide information on the assistance of programs and activities, and collaborate on public diplomacy events and VIP visits. Appendix B includes all the success stories that were submitted to USAID for consideration during the performance period and a list of photo galleries and videos about program activities, available online. Appendix E illustrates some of the media coverage that highlighted several CCEP projects and activities helping to disseminate the benefits of RE and EE initiatives.

The second dimension was focused on internal communications efforts to increase CCEP and USAID team members’ interactions and have the potential to increase CCEP impact and enhance our communications and outreach efforts by improving teamwork and collaboration and expanding our supporter’s base of CCEP knowledge. The objective was to address not only the content but also the process on how to maintain rational and organized flow of relevant information for reporting and communications purposes.

CCEP also used full branding and followed all USAID guidelines in the matter. This branding implementation plan hinged on three factors: 1) public communications to further the initiative’s goals, 2) telling the story of the project and its achievements, and 3) telling why that story and those achievements were possible – i.e., highlighting the support of the American people.

### 3.1.3 Performance Management Plan

The PMP was initially prepared in 2012 and revised as needed over the next four years, along with the annual work plans, or based changing circumstances or the need by USAID to add or modify specific indicators. The most recent full version of this plan was completed in September 2016. That version contained 12 reference sheets that detail the project’s indicators (USAID standard performance indicators and/or CCEP custom performance indicators). The analysis of CCEP’s final performance results associated with each of these indicators is included as part of Chapter 4 of this report.

In addition, CCEP fully complied with all project procedural and reporting requirements of USAID/Colombia’s Mission-wide MONITOR system. MONITOR was used as required to register,
3. Program Deliverables

catalog, ensure environmental compliance, report and update performance indicators for each project carried out by CCEP. CCEP accessed and updated MONITOR as needed but at least once every quarter.

Also, as part of the technical activities and in support of CCEP’s monitoring and evaluation activities, CCEP designed a GIS system to collect and display basic information associated with each of the projects carried out by CCEP. This GIS system uses a geographic viewer that can be accessed through CCEP’s website at [www.ccep.co](http://www.ccep.co) as illustrated below.

3.1.4 Environmental Mitigation and Monitoring Plan

CCEP prepared and delivered the required EMMP early in the first year of implementation, but according to guidance received from the Mission Environmental Officer at the USAID/Colombia Mission, it was established that the submission of the EMMP was not required as a separate deliverable. To ensure CCEP’s compliance with all matters related to regulation 216, CCEP utilized USAID/Colombia’s MONITOR system as requested by USAID /Colombia. MONITOR has built-in processes addressing all matters related to Reg. 216 to ensure that all mitigation and monitoring and compliance requirements are successfully confirmed, implemented and recorded; all registered projects are classified with actions/activities under three categories:

- **Category 1** activities, which are considered to have no environmental impact and are therefore part of the Categorical Exclusion list.
- **Category 2** activities, which are considered to have environmental impacts that can be mitigated through specific actions and are therefore on the Negative Determination with Conditions list.
- **Category 3** activities, which are considered to have significant environmental impacts and require a complete environmental assessment and are therefore on the Positive Determination list.
3. Program Deliverables

3.1.5 Security Plan / Manual

CCEP prepared and delivered its initial security plan early during the first year and it was revised and updated in late in 2012. This document included CCEP’s safety, security, and emergency policy and procedures to safeguard all project operations and to comply with all USG regulations.

This document outlined and addressed appropriate security protocols, reporting and emergency procedures. This document provided guidance on how to prevent, mitigate, avoid, or react to adverse security situations. It also included an internal cascade communication mechanism that followed the organization structure of the program with all Directors and Managers being responsible to contact their team members, including consultants.

No significant security threats were reported, although in some cases travel to certain remote areas was delayed, but under no circumstances CCEP’s staff or subcontractors were personally hurt or injured in any way.

3.1.6 Procurement Plan

CCEP’s procurement plan was prepared and delivered early in 2012. CCEP created this required document with the main purpose documenting how to plan and carry-out the procurement of supplies and equipment to be used in the activities implemented by the CCEP Project.

This document outlined and addressed CCEP procurement practices, including process and procedures required for project procurements at different cost thresholds, intended sources and origins of items being procured, monitoring and control of the use of non-expendable resources, specifications and estimated cost of non-expendables Items, commodity procurement guidelines, etc.

The procurement of all subcontractors, commodities, or consultants that were not listed in the approved CCEP budget were done in accordance with the standard procedures for simplified acquisitions, and all applicable AIDAR and FAR clauses.

3.1.7 Grants Manual and Plan

CCEP’s first Grants Manual and Plan was initially prepared and submitted early in the first year of implementation and was updated late in 2012. However, this version focused solely on grants and later into the program implementation it was revised /updated to include not only grants but also subcontracts, short-term technical assistance, and training and workshop costs when necessary.

The expanded Incentive Fund Management Manual (IFMM) was designed to provide as much flexibility as possible to encourage participation and/or collaboration of local entities. In particular, the Fund mostly supported activities under Task 2 to increase off-grid access to renewable energy services and under Task 3 to increase investment in energy efficiency and renewable energy.

The IFMM established how these funds were used to support a process of constructive engagement and planning between Government, communities, NGOs, local institutions, private sector and other relevant organizations including small and medium scale enterprises such as community and indigenous organizations. CCEP made every attempt to work with local partners that have proven know-how and experience in relevant focused areas.
3. Program Deliverables

3.1.8 Project information services

CCEP created and regularly maintained a variety of outreach platforms, including e-mail distribution of newsletters, project update stories for wide distribution on a regular basis with photos and descriptions of projects and activities, and a project web site available to the public, both in Spanish and in English (www.ccep.co).

As an example of these services, starting May 2012, CCEP generated weekly news updates that offered USAID, CCEP staff members and key local partners short summary descriptions of specific activities and progress made. That original format of the weekly news update remained in place until the end of 2013, when its distribution was limited to only USAID and CCEP staff members. Appendix D includes a sample of these weekly news updates, which continued to be distributed in that format through December 2014. By mid-2015, the program once again started producing internal and external newsletters in a new more dynamic and refreshed format with embedded links to relevant sites providing supporting information to target audiences. This new format continued to be published until December 2016. These newsletters are available at CCEP’s website www.ccep.co.

CCEP also created and disseminated other forms of media, such as videos to capture project impacts and stories. Early in the program implementation CCEP provided USAID a PowerPoint presentation highlighting project components and progress on a monthly basis. However, it was latter agreed with USAID that the monthly presentation was no longer necessary based on the other project information services that CCEP generated such the weekly and bi-monthly newsletters in addition to regular meetings with the COR.

3.1.9 Quarterly Reports

Nineteen quarterly reports were prepared over the program life providing details on the progress and challenges encountered by CCEP’s team members during the implementation of planned activities, and also presenting progress against performance indicators. These reports generally followed the same structure:

- Executive summary
- Key activities and progress by task, and their main accomplishments
- Activities programmed for next quarter
- Status of problems encountered and suggestion for their resolution
- Performance indicator results against targets
- Communications and outreach activities - Success stories, news media, etc. (if any)
- Appendices (when necessary) with reference information for performance indicators and results, technical assistance provided by the project, and project organization structure.

3.1.10 Annual Reports

Four annual reports were prepared over the program life detailing the main achievements Summary of key activities by task, and their main accomplishments

- Summary of key activities and achievements
- Summary of program expenditures
- Key activities results and summary by work stream
3. Program Deliverables

- Performance indicator results against targets
- Communications and outreach activities - Success stories, news media, etc. (if any)
- Appendices (when necessary) with reference information for performance indicators and results, technical assistance provided by the project, and project organization structure

3.1.11 Financial Reports

CCEP prepared and delivered two types of financial reports over the contract period:

- Accrual Report prepared each quarter – Twenty one accrual reports were submitted over the program life. In addition CCEP also agreed to submit, about two months after delivery of Accrual report, additional accounting information to facilitate USAID’s internal process to identify what invoiced charges were incurred in what month in other verify
- Quarterly Financial Status Report

3.1.12 Success Stories

CCEP submitted success stories regarding the impact of implemented activities on beneficiaries and their activities. Appendix C includes examples of the Success Stories that were submitted for USAID approval presenting some of the technical, social and environmental benefits and results. All success stories were accompanied by photographs of the activities described. In addition to these print versions detailing program success and case studies, CCEP worked with USAID to produce high quality photographs and videos depicting program accomplishments and personal stories. Photo galleries and videos are available online at the CCEP website and USAID’s YouTube channel.

Additional and more specific details of some of these Success Stories are included in the descriptions provided by task in Chapter 2 of these report and in Volume II of the separate three volume publication for wider distribution.

3.1.13 Final Report

The final report is embodied in this document and it discusses all activities and achievements of the contract tasks, from project start through completion. This document includes a summary of the accomplishments clearly indicating final tangible results, summary of deliverables/benchmarks, a section devoted to the lessons learned during implementation and a financial report indicating how funds were expended by line item.

This final report is complemented by a separate three-volume publication to further disseminate and leave a valuable public reference of the work accomplished by CCEP to local partners and GOC institutions. This publication provides a comprehensive and detailed description of over 200 direct CCEP projects and activities. That separate publication is organized in three volumes as explained in the introduction section of this report.

3.2 TECHNICAL AND OTHER REPORTS

During the program life CCEP produced a number of technical reports under Tasks 1, 2 and 3 which are part of the work described in detail under the task discussions in Chapter 2.
3. Program Deliverables

**Under Task 1: Renewable Energy and Energy Efficiency Enabling Environment**, CCEP prepared 5 major policy documents, technical regulations and other policy regulatory reviews (these are defined as studies that were prepared for specific partners, such as a government agency or state-owned enterprise). All of these documents were sent to or discussed with CCEP’s partners. CCEP also produced internal reports that were prepared by consultants and staff for the use of USAID and CCEP staff. CCEP also implemented over 20 clean energy demonstration and educational projects and activities.

**Under Task 2: Expanding Access to Renewable Energy Sources in Off-Grid or Under-served Areas**, CCEP prepared a variety of technical documents including but not limited to:

- Designs, prefeasibility, feasibility studies, TOR for installation and supervision of equipment and associated infrastructure required for each CCEP project
- Specialized studies such as soil conditions studies, hydrological measurements, forest and water use evaluations, permits and licenses, etc.
- Community development through training, capacity development, creation or strengthening of local energy associations

During the period of performance CCEP carried out RE projects in 65 communities in 17 municipalities and 10 departments.

**Under Task 3: Renewable Energy and Energy Efficiency Investment Promotion**, CCEP facilitated energy efficiency project transactions across a range of industrial sectors by supporting development and preparation of variety of technical and financial analysis and other specific activities and documents including but not limited to:

- Assessment of industrial sector and/or EE technologies
- Establishing new partnerships with potential project developers such as ESCOS, engineering companies, business associations, etc.
- Verifying engineering and financial structuring of identified projects
- EE project design
- Assisting selected companies to achieve technical and financial closure and bank financing approvals
- Developing project pipeline and serving as technical evaluators and auditors
- Technical guides

During the period of performance CCEP carried out EE projects in 44 industrial installations in 12 departments.

Sample of key standalone CCEP outputs in the form of technical documents, presentations and other data generated and delivered to local counterparts include:

**Example 1 Task 1** - Guide for the preparation of a “sustainable rural energization plan”. UPME with the support of the USAID Colombia Clean Energy Program promotes the development of “Sustainable Rural Energization Plan” (PERS in Spanish), to gather and analyze socioeconomic and energy information in rural areas, and
3. Program Deliverables

encouraging initiatives for the development of projects aimed at solving energy access problems in rural areas.

**Example 2 Task 1**- Technical support to power sector regulator to redefine off-grid tariff methodology. CCEP carried-out the study which was used by CREG to issue draft regulation addressing electricity tariffs in off-grid areas. CREG’s Resolution 004/2014 (ZNI tariff methodology under review) sets the stage to remunerate RE and hybrid systems in competition to diesel and grid expansion according to Levelized Cost of Energy (LCOE) based on 24-hour service over 20-year periods rather than just installed generation capacity.

**Example 1 Task 2** - 38 water pumping systems (solar/mechanically assisted) installed in La Guajira. CCEP designed and implemented this project in partnership with FCGI. CCEP produced technical designs and managed the local subcontractor that verified all designs and carried-out procurement and installation of solar pumping systems. CCEP and FCGI inaugurated the project in late April 2016 and USAID Mission Director visited in July 2016. CCEP also produced two tailored products for the inauguration event – and also as a tool to showcase and promote this type of solution for other Wayuu communities: a series of videos (1-minute, 3-minute and 7-minute versions, in Spanish and English, available in USAID’s YouTube channel) and a leaflet with project infographics, which can be downloaded from the CCEP website. CCEP also produced a grand-format photo exhibit with modular displays.
Example 2 Task 2 New MHP and rehabilitation of old water turbine, associated technical training and business components capacity building in Palmor - Magdalena. CCEP and IPSE performed technical studies to refurbish the existing 100 KW MHP and expand energy supply by installing an additional 150 kW unit. Construction began in February 2015 and was completed and fully operational by December 2016. CCEP contracted engineering firm overseen construction subcontractor producing associated final audit / verification report. CCEP also strengthen ElectroPalmor in technical and administrative issues, to enable the company to improve service provision for a rapidly growing town. Business strengthening was focused on general administrative and accounting practices, tariff design and fee collection strategies (such as pre-paid metering).

Example 1- Task 3 - Combustion optimization equipment in brick manufacturing industry. CCEP in alliance with CAEM assisted 19 brick manufacturers in Cundinamarca and Boyacá to install combustion optimization equipment to improve feeding and combustion systems for brick kilns reducing about 30% fossil fuel consumption. Technical support was provided to dimension and install pulverization, injection and combustion systems and opportunities to use coffee husk to further reduce fossil fuel consumption. CCEP staff also verified installations and any required adjustments; reviewed reports and results confirming expected metrics and performance.

Example 2 Task 3 CCEP developed technical guides for an efficient use of energy in the brick industry and industrial applications of biogas as a renewable energy source.
4. PROGRAM PERFORMANCE INDICATORS

4.1 INTRODUCTION

This section presents program performance as an integral program in line with the contract’s tasks and expected results. The results of individual tasks are presented and discussed in Chapter 2.

Progress during the first two years of program implementation was recorded through 18 indicators. During the life of CCEP, USAID restructured, consolidated, and updated several indicators, resulting in a list of 12 indicators applicable to this project, which are presented in this chapter. Appendix E includes a summary table showing CCEP performance indicators modifications through the life of the program.

All expected results achieved were impacted by more than one indicator, as shown in the following table.

![Figure 14 CCEP Expected Results and Program Indicators](image-url)
4. Program Performance Indicators

<table>
<thead>
<tr>
<th>Task</th>
<th>Project</th>
<th>Indicators Results</th>
<th>Expected Results</th>
</tr>
</thead>
</table>
| Task 1 | Thermal-based air-conditioning system in Universidad Pontificia Bolivariana (UPB) | - GHG (project): 1.32  
- GHG (lifetime): 59.40  
- Investment mobilized: USD 35,211.61  
- Institutions: 1  
- Person-hours of training: 27.00  
- Energy savings: 294,372 kW-h  
- CE capacity installed: 0.02 MW  
- CE capacity that achieved financial closure: 0.02 MW  
- Tools, technologies and methodologies: 1  
- Employment: 27 | - Enhanced capacity of MME, UPME, IPSE, energy companies and pertinent regional institutions to formulate and implement renewable energy policies, programs and projects.  
- Renewable energy and energy efficiency technologies and applications demonstrated and diffused to policymakers and general population through CCEP educational, awareness and outreach program.  
- 2,000 people gaining or improving employment, directly or indirectly, as a result of clean energy program interventions. |

With CCEP support, UPB implemented a thermal-based air conditioning system. This demonstration project uses solar thermal energy to power an air conditioning system in one of the Universidad
Pontificia Bolivariana (UPB) campus buildings. Using this state-of-the-art technology, UPB installed a wall and evaporative cooling system coupled to absorption refrigeration and solar collectors. There is great potential to replicate this project, as the technology can also be used for air conditioning systems in hotels, hospitals, and office buildings across the country. This project touches several key issues in Task 1 expected results:

- UPB is an educational institution with regional presence and proven capacity to formulate and implement projects;
- The initiative demonstrated innovative uses of renewable energy in refrigeration, thus showcasing project results to university staff, students, and general public; and
- Improved employment, as the technology was installed in UPB’s Registrar’s Building.

CCEP and IPSE designed and implemented a 20kW MHP in Cabildo Indígena Rio Pangui El Yucal. This intervention shows how Task 2 project indicators impact the task’s expected results:

- The JASE and the productive initiatives supported by CCEP are clear examples of business models that focus on long-term sustainability;
- The project itself is an electrification project that benefits, in this case, over 450 people;
- The productive initiatives (rice and corn crops) supported by the program are income generation opportunities for project beneficiaries; and
- The JASE was trained in technical and business issues to operate the MHP.

Projects will facilitate energy savings, energy cost savings and renewable generation (number determined by recommendation of aforementioned analysis). Significant project impacts in terms of energy and cost savings and improved competitiveness of Colombian industries.
The example above, Delta, has a particular nature since the company worked with CCEP in two separate instances. First, Delta received direct technical assistance that led the company to improve production processes. Later on, through its participation in CCEP’s boilers & kilns project, installed a carbojet, improved even further combustion, and replaced coal with coffee husk. CCEP work in Delta show how program indicators impact Task 3 expected results:

- Both interventions greatly impacted energy savings; and
- Replacing coal with coffee husk not only had an impact in cost savings and competitiveness, it also positioned the company as an example of biomass resources for industrial purposes.

These are only three examples of how CCEP projects contributed to overall success and exceeded program indicator targets expected results.

### 4.2 RESULTS

Despite some positive initial progress and inroads, CCEP faced many obstacles and implementation challenges during program life, which affected pace of initial implementation. However, CCEP’s management and technical teams were able to overcome these hurdles and were able to accelerate the pace of implementation by addressing obstacles that enable take-off of projects initially formulated, and adding new ones to the pipeline of projects and activities. This enabled CCEP to reach - and exceed - all program targets. Life program targets and results are presented in Table 11.

<table>
<thead>
<tr>
<th>Performance indicator</th>
<th>Unit</th>
<th>Life of Program Target</th>
<th>Final Results</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of mitigation and/or adaptation tools, technologies and methodologies developed</td>
<td>Tools</td>
<td>10</td>
<td>40</td>
<td>400%</td>
</tr>
<tr>
<td>Number of laws, policies, strategies, plans, or regulations addressing climate change</td>
<td>Number</td>
<td>10</td>
<td>19</td>
<td>190%</td>
</tr>
<tr>
<td>GHG emissions reduced, sequestered, and/or avoided during program life</td>
<td>Metric tons of CO2e</td>
<td>80,000</td>
<td>103,911</td>
<td>130%</td>
</tr>
<tr>
<td>GHG emissions reduced, sequestered, and/or avoided projected for the entire lifetime</td>
<td>Metric tons of CO2e</td>
<td>495,000</td>
<td>1,212,761</td>
<td>245%</td>
</tr>
<tr>
<td>Expected lifetime energy savings from energy efficiency or energy conservation</td>
<td>Thousand kilowatt-hours saved</td>
<td>1,500,000</td>
<td>2,118,361</td>
<td>141%</td>
</tr>
<tr>
<td>Amount of investment mobilized</td>
<td>USD</td>
<td>5,000,000</td>
<td>19,824,143</td>
<td>396%</td>
</tr>
<tr>
<td>Clean energy generation capacity installed or rehabilitated</td>
<td>Total capacity of the system in MW</td>
<td>0.5</td>
<td>2.31</td>
<td>463%</td>
</tr>
<tr>
<td>Clean energy generation capacity supported by USG assistance that has achieved financial closure</td>
<td>Total capacity of the system in MW</td>
<td>0.24</td>
<td>2.05</td>
<td>856%</td>
</tr>
<tr>
<td>Number of institutions with improved capacity to address climate change issues (clean energy)</td>
<td>Institutions</td>
<td>47</td>
<td>146</td>
<td>311%</td>
</tr>
<tr>
<td>Number of person hours of training completed</td>
<td>Hours</td>
<td>40,000</td>
<td>133,517</td>
<td>334%</td>
</tr>
<tr>
<td>Number of people gaining or improving employment, directly or indirectly, as a result of clean energy program interventions</td>
<td>Persons</td>
<td>2,000</td>
<td>2,899</td>
<td>145%</td>
</tr>
<tr>
<td>Number of CCEP pre-investment activities</td>
<td>Activities</td>
<td>60</td>
<td>86</td>
<td>143%</td>
</tr>
</tbody>
</table>
4. Program Performance Indicators

The challenges faced by CCEP in developing and implementing transformative clean energy projects were formidable mainly because:

- CCEP projects were complex and therefore time consuming, not just because they introduced technologies or practices not yet widespread, but because they involved many different actors, decision-making instances and administrative procedures.
- Many of the initially identified industrial energy efficiency and renewable energy projects were delayed by the lack of appropriate financing mechanisms and commitment of the private companies’ top management.
- Difficulties in timely commitment of public agencies development funds.
- GOC agencies had a very slow response to CCEP’s support for rural planning activities and project development.
- Institutional and administrative informality and weakness of rural community-based organizations was a risk for project implementation.

In spite of these challenges, CCEP surpassed program targets. Significant examples in project contribution to indicators are listed in the following bullets:

The following bullets present CCEP indicators and the projects and activities that enabled CCEP to exceed program targets.

- **Number of mitigation and/or adaptation tools, technologies and methodologies developed**: CCEP’s most significant intervention in surpassing the target of tools, technologies and methodologies was program work in PERS, both through direct involvement in PERS Nariño, Tolima, and Guajira, and continued support to UPME and other GOC counterparts in PERS Chocó, Cundinamarca, Orinoquia, and Putumayo. Of the 40 tools/technologies/methodologies reported by the program, PERS contributed 17, close to half the program indicator.
- **Number of laws, policies, strategies, plans, or regulations addressing climate change (clean energy) proposed/adopted/implemented**: Eight of the 19 laws, policies, strategies, plans or regulations achieved by CCEP were the result of program work and support in legal and regulatory issues for renewable energy and energy efficiency in Law 1715/2014. This also reflects the continued interactions with GOC allies, in spite of obstacles and delays caused by institutional voids in MME and other energy sector institutions.
- **Number of beneficiaries with improved clean energy services**: 7,926 beneficiaries of the 23,588 - one third of the program result - were the direct result of CCEP support to Cancillería’s Telemedicine initiative.
- **GHG emissions reduced, sequestered, and/or avoided during program life / GHG emissions reduced, sequestered, and/or avoided projected for the entire lifetime of projects**: 20,987 tons of CO2(e), which resulted of CCEP work with Carvajal in PPF, is 20% of the program's 103,911 tons of CO2(e) reported in this indicator; and, regarding project lifetime, Carvajal contributed 470,944 tons of CO2(e), out of the 1,212,761 - more than 35% of the final result in this indicator.
- **Expected lifetime energy savings from energy efficiency or energy conservation**: CCEP work with Coltejer is a good example of how combustion optimization interventions contribute to clean energy goals. Out of the 2 MWh in energy savings accomplished by CCEP, Coltejer contributed over 400 kWh to the goal, 25% of the program indicator.
- **Amount of investment mobilized**: Carvajal contributed over USD 5 million to this program indicator, more than 25% of the USD 19,824,143 achieved in this indicator. The USD 5 million
investment is the result of four distinct PPF studies that recommended improvements to production processes.

- **Clean energy generation capacity installed or rehabilitated / Clean energy generation capacity supported by USG assistance that has achieved financial closure**: 1.89 MW of the 2.31 and 2.05, 80% and 90%, respectively, accomplished by CCEP was contributed by Carvajal, thanks to two PPF studies that lead the company to make improvements and implement recommendations.

- **Number of institutions with improved capacity to address climate change issues (clean energy)**: 16 of the 146 institutions reported in this indicator (more than 10%) were the result of CCEP support to Dinamos, where school teachers and students were trained in renewable energy technologies and energy efficiency practices.

- **Number of person hours of training completed**: Dinamos was, by far, the project with most person-hours of training. Teachers and students participating in this initiative reported 85,284 person-hours of training, more than half of the 133,516 person-hours achieved by the program.

- **Number of people gaining or improving employment, directly or indirectly, as a result of clean energy program interventions**: Close to one third of the 2,899 improved employments reported by the program were contributed by CCEP work with FCGI in the solar and mechanically assisted water pumping project in La Guajira.

- **Number of pre-investment activities**: CCEP is a program with a high level of technical content. Thus, pre-investment activities were key to determine whether or not the program would support a particular intervention. CCEP work with IPSE to build a 20 kW MHP in Yucal, for instance, was implemented only after four pre-investment activities were developed. The actions resulted in detailed studies that served as the program's blueprint for the civil works and the electric installations.
5. LESSONS LEARNED

This section of the report highlights the key lessons learned throughout the development and implementation of the Colombia Clean Energy Program. In the preceding chapters, lessons learned from the variety of individual projects and program implementation strategies have been discussed. The publications for broad dissemination highlight how each project was conceived, how obstacles faced were surpassed (or, if not, why), and how these projects and technical activities provide examples and guidance for replication and expansion of clean energy actions in rural development, industrial processes, education and energy planning and policy making at the partner, regional, national and sector levels. This section focuses on those core strategies and characteristics that became an essential part of the CCEP model of intervention, and can orient future action towards embedding innovative concepts such as clean energy into mainstream thinking and action.

Lesson One. Less theory, more action. While high-level planning and policy making can generate great transformational change, it can also become ineffective declarations of good intention. Institutional inertia and lack of concrete actions to follow through with them can defeat their purpose. Just issuing official texts is not enough. Plans, policies, laws or resolutions, need much more than promulgation or publication to be effective. They require instrumentation, socialization, feedback and ongoing adjustments, updates, and refining. PROURE is a case at hand, originating in 1990’s policy, becoming law in 2001, and motivating an “indicative action plan” in 2010 – for a long time it was an ambitious wish list with very little actual implementation or measurable impact. In contrast, the Sustainable Rural Energization Plan (PERS) strategy designed with UPME took off with a single methodological pilot study in one department and has rapidly extended throughout the country due to its well-grounded bottom-up rather than top-down conception, continuous technical improvements and operational organization. Similarly, by deciding to act and take into account energy consumer motivation, in 2012 UPME found a way to help spur over USD $700 million of investment in energy efficient transportation and industry – part of many PROURE targets – through tax incentives that could have been established years earlier but were not acted upon. Designing the resolution, evaluation methodology and administrative procedures that made this possible took no more than five months, including informal public audience and feedback.

As discussed, Law 1715 passed in May 2014 marks a transformational departure from 20 years of strong resistance in the energy sector to intermittent generation, prohibition of self-generators selling excess power to distribution grids, even remuneration of renewable energy or hybrid generation in isolated, off-grid communities. But it was not a sudden or surprising development. The market was prepared to spearhead small- to large-scale clean energy investment, and the government had the technical capacity to rapidly develop its regulatory decrees and procedures to allow its implementation. Though advances have been made in some areas, the market feedback is that it is taking too long for clear signals and rules to be finalized.

Lesson 2. Work directly with energy users. The central and essential actors in the adoption of clean energy technologies are the communities, companies and civil society that must appropriate them. It is within communities, industry and rest of society that renewable energy and energy efficiency can and must be appropriated if energy and environmental policy objectives are to be reached. Institutional and financial support from programs such as CCEP, or incentives and disincentives
5. Lessons Learned

(regulations) from government, can contribute to adoption of these technologies, but it is within energy users that change must happen. This means that if programs like CCEP want to contribute to make clean energy happen, they have to work directly with energy users.

CCEP’s participatory approach to all tasks extended up to its closing event Clean Energy Perspectives in Colombia – Recent Experiences to Construct Futures

Communities, businesses and university PERS teams participating in 5 CCEP educational and demonstration projects, 10 CCEP rural renewable energy projects and 7 industrial energy efficiency were the protagonists who presented projects at the event in Bogotá, not program staff or central government.
5. Lessons Learned

In the case of vulnerable rural communities, introducing unfamiliar alternative energy technologies presents a challenge that can be surmounted with technical assistance, training for operations and maintenance and strengthening community organization. In CCEP’s intervention model, it is essential to involve community participation from the beginning and provide that kind of training and support throughout the project cycle, to empower them to maintain and extend these new systems beyond the Program’s lifetime.

Regardless of the scale and sector of the industries involved in energy efficiency projects undertaken with CCEP assistance, to assure appropriation the Program accompanied the companies from initial technical designs, financial structuring, implementation and initial operation of the combustion optimization or other technologies involved. In the smaller companies, with little or no internal engineering support, CCEP found it essential to accompany management and workers in familiarizing themselves with the new systems installed and adjusting to the operational changes they entail, during sufficient time assure optimal performance of the technologies and best impact from energy, environmental and occupational health perspectives.

There is already some general social awareness of the virtues of renewable energy and energy savings. It is not a difficult message to get through. But to instill clean energy action in civil society, CCEP employed several strategies – and learned some of the lessons that follow.

Lesson 3. Involve and empower regional allies – regional public institutions, universities, businesses, energy companies, technology suppliers. CCEP searched and engaged regional actors as allies throughout its three tasks. Task 1: Regional universities, educational and research facilities participated actively in the PERS process and the demonstration and educational projects, providing fresh ideas, enthusiasm and capacity to work for their regions, institutions and their target populations (students, professors, visitors). When it comes to energy needs, regional problems can no longer be solved at the central level. Solutions are in the regions, and the national-level agencies involved in the PERS become enablers of the solutions jointly identified. The two-way alliance between national and regional institutions in developing each PERS should also become a useful model for planning electricity coverage extension, since the prevailing centralized planning scheme has been based on standard solutions for communities (grid extension, diesel micro-grids) regardless of energy needs, capacity to pay and resource availability needs to be adjusted to make them feasible and sustainable.

Regional stakeholders and technology suppliers are critical to developing renewable energy projects with rural off-grid communities, even more so now that the Colombia Clean Energy Program has come to an end. Regional stakeholders can include universities involved in PERS efforts, public or private companies partnering with CCEP for project development, and even local professionals engaged in technical assistance or technology implementation. An effort was made to competitively engage subcontractors, professionals and technology suppliers in cities in the general area of influence of the rural communities involved in CCEP projects, so they could have closer access to them in case of any technological glitches or need to expand systems on their own. JASES were trained in routine maintenance but also encouraged to set aside part of their budget for sporadic inspections by regional suppliers. These human and technical resources have already been invited by project communities to help solve any pending issues after project implementation.
5. Lessons Learned

Lesson 4. **Education is a relevant actor in creating a favorable climate for clean energy in Colombia.** CCEP’s work with 35 isolated rural schools, 16 high schools in Cundinamarca, universities and technological training centers in seven cities and the Botanical Garden in Bogotá, confirms that the educational community can become both users and multipliers of clean energy solutions to multiple social needs. Specific, replicable educational contents and methodologies were developed for Cundinamarca high schools and the botanical garden for continued use and motivation after CCEP projects finalized. Students and teachers in the Cundinamarca program have multiplied clean energy initiatives and applications (such as bicycle operated cell phone chargers) in their schools, households and home towns. Professors, researchers and students at the University of Nariño have continued working on clean energy solutions both for rural communities and urban development objectives several years after completing their departmental PERS. Proof is two national electricity sector AMBAR innovation prizes (2014 and 2016) and the implementation of the Campus Verde solar-powered electric bicycle project. PERS survey teams in Cesar, Tolima have continued lending technical assistance in their professional spheres to communities they visited during their field work. Students in Punta Soldado, Chachajo and Punta Soldado formed and maintained “Ecoclubs” as part of CCEP processes.

Lesson 5. **The combination and articulation of support to policy and strategy formulation with the development and implementation of concrete renewable energy and energy efficiency field projects, in conjunction with communities, economic agents and the energy sector, contributed to the creation of a favorable environment for clean energy in Colombia.**

CCEP projects can be shown as successful examples of the contribution clean energy can make to sustainable rural, business and societal development, constituting key elements feeding into the construction of public policy, planning methodologies and regulatory development. The “hands on, make things happen” approach taken by the Colombia Clean Energy Program in all its work fronts, built trust and technical confidence that positioned the program as a reference point on clean energy in GOC, business, academic and development spheres. CCEP policy advice was respected as coming from field experience, and communities and businesses. Participating communities and companies perceived not only the technical capacity and dedication of CCEP field teams, but that they could express their needs and opinions up the institutional chain through CCEP’s links to policymakers.
6. FINANCIAL REPORT

CCEP was a bilateral technical assistance program funded by USAID that began in January 2012 and was originally scheduled to run for 60 months (until January 2017). In November 2016, the project's end date was extended through March 31, 2017.

CCEP exceeded all expected indicator results spending significant less resources than those included in the contract ceiling. This means that from a cost perspective CCEP was efficient and beneficial to US Taxpayers.

USAID obligated a total of USD 17,568,406 to the contract and at the time of the writing of this report, CCEP had invoiced USD $17,167,052 through the period ending February 28, 2017, approximately 98% of the obligated funding. Figure 15 presents an itemized summary of cumulative program costs invoiced between January 2012 and February 2017.

![Figure 15 Program Costs](image)

CCEP’s successfully completed essentially all technical activities associated with each project by December 2016 and the program reached a historical level of activity reflected in the monthly invoice of about USD 1 million in August 2016 and another subsequent invoices close to $800k each. As shown in Figure 16, average monthly program expenditures increased steadily every year during the performance period reflecting CCEP’s implementation pace which was most intense during the last two years for the reasons discussed in Chapter 2.
Figure 16 Annual average monthly invoices
# APPENDIX A LIST OF CCEP’S PARTNERS

## CCEP’s Joint work with Implementation Partners

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Name</th>
<th>Task 1</th>
<th>Task 2</th>
<th>Task 3</th>
</tr>
</thead>
<tbody>
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<td><strong>PUBLIC INSTITUTIONS</strong></td>
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<td><strong>National Government</strong></td>
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<td>Post Conflict</td>
<td>High Commission for Post Conflict, Human Rights and Security&lt;br&gt;Alta Consejería para el Posconflicto, los Derechos Humanos y la Seguridad</td>
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<td>UPB</td>
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### Public Regional Institutions

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### Public Rural Schools

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<td>Centro Educativo Indígena Número Uno Escuela Rural Kasumana</td>
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<td>LA PO</td>
<td>Centro educativo La Po</td>
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<td>LA PRIMAVERA</td>
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<td>MAJORE</td>
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### Public Rural Schools

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<td>PABLO MUERA</td>
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<td>PORROSO</td>
<td>Centro educativo Porroso</td>
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<td>SAN MIGUEL</td>
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<td>Centro educativo Valle de Pérdidas</td>
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### COMMUNITY ORGANIZATIONS AND NGOs

#### Community Based Groups

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<td>Asociación de productores del Alto San Jorge ASOPRONAL</td>
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<td>Consejo Comunitario de Bajo Calima</td>
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<td>Barranco</td>
<td>JASE Barranco</td>
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<td>Chachajó</td>
<td>Resguardo Indígena de Chachajó</td>
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<td>Confederación Indígena Tayrona</td>
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<td>Comité Cafeteros</td>
<td>Comité Departamental de Cafeteros del Cesar y La Guajira</td>
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<td>El Yuca</td>
<td>Cabildo indígena Rio Panguí “El Yuca”</td>
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<tr>
<td>Gun Aruwun</td>
<td>Comunidad del corregimiento de Gun Aruwun (Sabana de Crespo)</td>
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<td>IPS Wintukwa</td>
<td>Instituto de Previsión Social IPS Wintukwa</td>
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<td>Joaquinsito</td>
<td>JASE Joaquinsito</td>
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<td>KAGGABA</td>
<td>Organización Gonawindúa Tayrona Pueblo KAGGABA</td>
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<td>Kogui</td>
<td>Centro Etnoeducativo Indígena Kogui de San Antonio</td>
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<td>La Concepción</td>
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<td>La Plata</td>
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### Community Based Groups

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<td>Asociación de pescadores PIMPESCA</td>
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<td>Puerto Pizaro</td>
<td>JASE Puerto Pizario</td>
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<td>Puerto Valencia</td>
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<td>Red Ecoagro</td>
<td>Asociación &quot;Red Ecoagro&quot;</td>
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<td>Resguardo Arhuaco</td>
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<td>Resguardo Arhuaco de la Sierra</td>
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<td>Seynekun</td>
<td>Seynekun, la asociación de productores indígenas.</td>
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<td>JASE Silva</td>
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### Community Based Groups

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<td>Wayúu X 38</td>
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<td>Yu Dxicxkwe Reserve</td>
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<td>FIS</td>
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<td>Fundacion Cerrejon</td>
<td>Fundacion Cerrejon Guajira Indigena</td>
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<td>Fundacion Pro - Sierra</td>
<td>Fundacion Pro-Sierra</td>
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<td>PASTORAL SOCIAL</td>
<td>Faith based Secretariat for Riohacha</td>
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<td>Patrimonio Natural</td>
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### PRIVATE SECTOR

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<td>ANDESCO</td>
<td>National Association of Public Services and Communications Companies</td>
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<td>ANDI</td>
<td>National Business Association</td>
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<td>Corporación Ambiental Empresarial - CAEM</td>
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<td>CCB</td>
<td>Bogota Chamber of Commerce</td>
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<td>CCEE</td>
<td>Colombian Energy Efficiency Council</td>
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<td>FEDECAFE</td>
<td>National Coffee Growers Federation</td>
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#### National Banks and Financial Institutions

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<tr>
<td><strong>FDN</strong></td>
<td>Financiera de Desarrollo Nacional</td>
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</table>
| **Finamerica** | Finamerica Finance Company  
Finamerica Compañía de Financiamiento |
| **Findeter** | Territorial Development Finance Company  
Financiera de Desarrollo Territorial |
| **Fundacion Social** | Fundacion Social |
| **PROCREDIT** | Banco ProCredit Colombia S.A. |
| **Valor y Estrategia** | Valor y Estrategia |

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<td><strong>ALICO Company (Project structured but cancelled)</strong></td>
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<td><strong>Alumina S.A</strong></td>
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<td><strong>Cartones y Plásticos La Dolores</strong></td>
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## Companies

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<td>Cooperativa Lechera de Antioquia</td>
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<td>Colombina S.A.</td>
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<td>Tiendas Corina S.A.</td>
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| ISAGEN | ISAGEN Energía Productiva Energy Company | ✓ ✓ |
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| Ladrillera Bella Vista | Ladrillera Bella Vista | ✓ |
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### INTERNATIONAL ORGANIZATIONS

#### Other USAID Projects

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#### International / Multilateral Organizations

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APPENDIX B  SUCCESS STORIES SUBMITTED TO USAID

This Appendix illustrates some achievements described in each of the main components of the program. The following examples of Success Stories were submitted to USAID presenting some of the technical, social and environmental benefits and results.

- Tax Incentive Regulation for Encouraging EE investment (Task 1)
- San Antonio Indigenous Community (Task 2)
- Los Cerros Brick Manufacturing Company (Task 3)
- Solar energy for Utria national park (Task 2)
- GHG emissions reduced in brick production (Task 3)
- A clean slate in ethnic education (Task 2)

Other “Success Stories” and “Before and After” cases were drafted or were under consideration for showcasing CCEP’s achievements include the following ones:

- Sustainable Rural Energy Plan (PERS) Nariño
- Santa Rita – Brick Manufacturing Company
- Helados Tonny - Ice Cream Production Company (after and before photo template)
- Workshops and seminars to structure Project Preparation Facility (PPF) for clean energy projects

In addition, the program produced photo galleries and videos, available online at www.ccep.co/comunicaciones:

- **Photo galleries**
  - Feria de la energía para niños
  - Invierta y gane con energía (Cartagena, Medellín, Cali, and Bogotá)
  - Energía solar en Punta Soldado, Buenaventura (Punta Soldado, Buenaventura, V. del Cauca)
  - STOP: jeans, energía y moda
  - Energía total en el Primavera Fest
  - Palmor es energía (Palmor, Ciénaga, Magdalena)
  - Energía a muy bajos grados (Urrao, Antioquia)
  - Textiles con eficiencia energética en Coltejer
  - Ka’i otta Wuin - Energía del Sol para obtener Agua en La Guajira
  - Guajira Power
  - Energía a altos grados (Supía, Caldas)
  - Colombia es energía
  - Termilenio se mueve con energía Limpia
  - Carrera Verde: ¡100% energía Limpia!
  - Energía Limpia para El Yucal (Nuquí, Chocó)

- **Videos:**
  - Utría
B. Success Stories Submitted to USAID

- El Yucal
- Supía y Urrao
- Energía limpia Wayuu
- Punta Soldado, Buenaventura
B.1 TAX INCENTIVE REGULATION FOR ENCOURAGING EE INVESTMENT

New Tax Incentive Regulation encourages US $231M in clean energy investments

Although the Colombian tax law had contemplated tax incentives for investments in systems improving the quality of the environment since 1996, investments in EE or RE equipment were unable to benefit from such deductions until the promulgation of the EE/RE Tax Incentive Resolution 563 in December 2012. USAID’s Colombia Clean Energy Program (CCEP) worked together with the Colombian Mining and Energy Planning Unit (UPME), as well as with the Ministry of Environment and Sustainable Development (MADS) and the National Environmental Licensing Agency (ANLA), in drafting the final resolution and defining procedures and roles of each of these bodies in processing and issuing the 16% value added tax (VAT) and 20% income tax reductions for energy efficiency (EE) or renewable energy (RE) investments in Colombia.

CCEP supported the successful public roll-out and dissemination activities through a series of workshops to explain the procedures on how to apply for the EE/RE Tax Incentives. These workshops were delivered during April and May, in Bogota, Medellin, Barranquilla, Cali, Pereira and Bucaramanga. The Seminars were sponsored by UPME, MADS, ANLA, the National Business Association of Colombia (ANDI) and CCEP, reaching a total of 887 attendees.

Sponsoring partners presented appropriate regulatory background and required application processes, and answered questions concerning two case studies. These hypothetical cases addressed some of the common issues faced by applicants and brought together representatives from local public and private sectors. These seminars achieved the objective to inform and encourage businesses, industry and entrepreneurs to take advantage of these incentives and invest in energy efficiency and renewable energy equipment.

As a result of Resolution 563 and the workshops, UPME has received a total of 24 project proposals through August 2013, where the tax incentive amounts vary depending on the size of the project. These projects, which range from wind resource evaluation to clean energy public transportation equipment, involve about $231.3 million in investments and about $37 million in tax breaks. Angela Gómez, Environmental Regulation Director at ANDI, notes that the possibility to apply for tax incentives is a major first step that should be able to tilt the balance towards more frequent and important EE/RE investments, gaining significance in the country’s efforts to mitigate climate change and increase competitiveness in the region.
B. Success Stories Submitted to USAID

B.2 SAN ANTONIO INDIGENOUS COMMUNITY

SUCCESS STORY

Access to Clean Energy for Indigenous Kogui Community in Colombia

Students and staff at the San Antonio boarding school have access to clean energy and water, improved living and working conditions.

The San Antonio boarding school is a small facility servicing 243 children from the indigenous Kogui villages of Pueblo Viejo and San Antonio in the Sierra Nevada de Santa Marta. The school used to have a small micro hydroelectric power plant (MHP) that never quite worked to capacity due to mistakes in its installation and lack of servicing and repairs, offering an average of only 4-8 hours of power a day. The school’s kitchen, which served food for a total of 271 students and staff, used an old highly inefficient woodstove for cooking and for boiling water. The school’s health center also lacked energy most of the time, making it impossible to stock on vaccines or anti venom serum for snake bites, needed in this isolated area.

USAID’s Colombia Clean Energy Program (CCEP) visited the town and assessed its energy needs. CCEP designed a solution to include the reparation and optimization of the MHP in order to meet energy demand, as well as the installation of additional renewable energy systems for the Kogui Education and Health Centers. The solution included the installation of a water purification system, an improved cook stove, support for setting up a small fuel-wood plot (3 ha) and installation of 17 solar lamps, benefiting the school children and staff. The Pastoral Social de Rionzicha, the religious entity that supports the boarding school, along with the boarding school community of San Antonio, contributed 50% of the funds for this project.

The restoration of the MHP consisted in remodeling and improving the civil and structural works of the intake and installing new electronic equipment, for easy operation and control. A member of the community was trained and given the job as responsible for tending to the MHP and making sure the water intake point remains clear of large leaves or branches that might obstruct the water flow. The 1.5 kW MHP that now runs 24 hours a day, provides lighting for classrooms, the restaurant and boarding rooms at the school. It also powers the new water purification system and runs a grass cutter for feeding the school’s cattle and mules; and, provides energy for the health center adjacent to the school, where vaccines and medicines can be kept at adequate temperatures. The new larger efficient woodstove uses less wood, takes less time to cook and is a lot more comfortable to work with. CCEP installed a total of 17 solar lamps which significantly reduce indoor air pollution, and are currently being used by native school teachers at their homes for preparing classes at night. Although the indigenous community was skeptical at first, according to Francisco Sauna Limaco, 1st grade teacher at the school, everything is working and life has become easier for all, “I have no electricity at home, now I can use the solar lamp at night to study more and to write my reports for the school children.”
B.3 LOS CERROS BRICK MANUFACTURING COMPANY

Residual heat recovery project eliminates the need to burn coal

Los Cerros brick factory, located in Planeta Rica, Department of Cordoba, is a company dedicated to the processing and marketing of clay bricks, which burned coal to generate heat for its brick drying process. USAID’s Colombia Clean Energy Program (CCEP) visited the factory to determine the energy needs and evaluate the GHG impacts of the company’s productive process in an effort to promote energy efficiency practices in the region and the sector. CCEP’s evaluation determined that the air quality at Los Cerros was highly affected as a result of burning coal. The smoke, ash and particulates generated by this burning process represent a health hazard for the factory workers, and could have triggered sanctions from the local environmental agency for air pollution. Coal consumption costs also represented a significant portion of the company’s operating costs, reaching an average of COP $5.7 million per month in coal purchases.

CCEP evaluated the alternatives and proposed using waste heat from the neighboring Ecofuego Company, dedicated to the incineration of hazardous waste. Consequently, the use of the residual heat or hot air from the neighboring incinerator would account for a significant reduction in emissions, operating costs and improved profitability for Los Cerros. Both companies were in agreement and CCEP designed and implemented the project.

CCEP designed and supervised the construction of the new more spacious drying chambers in a plot of land closer to the neighboring plant, where new columns, new flooring and roof where set up. Twelve axial fans were installed to ensure proper air flow, as well as three centrifugal fans responsible for injecting and extracting air from the drying rooms. Three hundred drying shelves were constructed, where the clay bricks are lined to dry by a pusher. Finally, a hot air duct – with a total length of 60 linear meters – was built using reinforced concrete and bricks, in order to bring the otherwise wasted heat all the way from the incinerator to the brick factory.

Thus, thanks to this energy efficiency project Los Cerros eliminated the use of coal from its brick drying process, and greenhouse gas emissions have been significantly reduced - estimated at 1,814.5 avoided CO2 tons per year. This waste-to-energy project represents a replacement of fossil fuel equivalent to 552.5 million kilocalories per month. Thanks to the new installations and shelving system the plant has doubled its production of bricks. Mr. Eduar Duque, Production Coordinator at Los Cerros, expressed the workers’ pride since the implementation of the new drying system, as the process has improved and the production augmented, and most importantly, the zero pollution factor has created significantly better working conditions, since there is no dust, no noise and a much better working environment overall.
B. Success Stories Submitted to USAID

B.4 SOLAR ENERGY FOR UTRIA NATIONAL PARK

USAID provides clean energy solutions to support ecotourism activities in Utria National Natural Park

On February 2014, USAID, through the Colombia Clean Energy Program (CCEP), finalized the installation of photovoltaic (PV) systems for the generation of clean energy in Utria National Natural Park, located in the municipality of Bahia Solano (Choco). With more than 54,000 hectares and hosting four of the most endangered ecosystems (tropical rainforest, mangrove, marine and coral reef), Utria is considered as one of the most diverse natural parks in Colombia and the world. This was the first project to be completed by USAID, the Institute of Planning and Promotion of Energy Solutions in the Non Connected Zones (IPSE) and Patrimonio Natural as part of a broader agreement signed by USAID and IPSE in August 2013 to co-finance and implement sustainable renewable energy solutions in four underserved areas located in the Pacific (Utria and El Yucal) and Sierra Nevada de Santa Marta (Palomar and Bunkwimake).

With the ongoing participation of Unidad Administrativa Especial del Sistema de Parques Nacionales Naturales, USAID performed technical visits and identified key energy shortages affecting the park’s organizational and technical capacities. USAID’s evaluation determined that due to limited resources, the park was able to supply only 58% of its required infrastructure. Furthermore, lack of clean and stable energy sources constituted a critical barrier for the development of its mission and goals. Thus, USAID proposed to install solar energy components as a viable and sustainable solution to guarantee permanent and clean energy supply for the park’s facilities and to support tourism and educational activities developed by the local operator NGO Mano Cambiada. Installed components include: PV systems to provide LED illumination in 3 tourist bungalows and 1 administrative bungalow for Unidad de Parques; two PV systems for LED illumination in the Auditorium and the Interpretation Center; two solar refrigeration systems to ensure proper food conservation in restaurant facilities; and the optimization of the park’s telecommunications infrastructure through the refurbishment of a damaged solar system.

Thanks to this project, USAID has generated important environmental and operational benefits for the park’s staff and visitors. By replacing fossil fuel consumption with solar energy, the project has significantly reduced GHG emissions as well as the costs associated with fuel transportation. Additionally, it has provided a reliable energy infrastructure with reduced operational and maintenance costs, fostering energy efficient practices and supporting the park’s administrative staff in their endeavor to stimulate ecotourism in the region, provide a quality service for visitors and promote clean energies as a viable alternative for the conservation of biodiversity.
B.5  GHG EMISSIONS REDUCED IN BRICK PRODUCTION

USAID | COLOMBIA
SUCCESS STORY
Burning less coal increased brick production

New brick furnace burns 29% less coal reducing GHG emissions by avoiding over 3,000 tons of CO2e emissions per year while increasing monthly production over 200%

Sugrés Brick Factory, located in Supia, Caldas, was founded 29 years ago and is a company dedicated to the processing and marketing of clay bricks. Before the implementation of the project, the company produced in average 802 tons product / month and employed 49 people. Clay products, mostly bricks, were loaded and fired to high temperatures in furnaces called kilns, which in this case were kiln type beehive. These kilns were burning coal feed manually by workers to produce the required temperatures to harden and strengthen the bricks. After cooling, the bricks were removed and packaged. Product stocking, burning, cooling, and delivery took 11 days, at best; production processes were irregular with uneven baking cycles, resulting in high coal consumption and costs and abundant defective bricks. In addition, working conditions were severe as the smoke, ash and particulates generated by this burning process represented a health hazard for the factory workers and were also affecting the environment.

USAID’s Colombia Clean Energy Program (CCEP) assisted Sugrés to carry-out the project which involved replacing the five inefficient beehive kilns with a tunnel kiln with automatic coal feeding to reduce GHG by lowering the amount of coal burning and at the same time optimizing its production process, product quality, and working conditions. CCEP provided technical assistance to guide Sugrés in setting up the production line, maximizing heat recovery with improved technology. The company received a $ 500,000 loan via Bancolombia’s Environmental Credit Line to build the new kiln tunnel.

As a result of the implementation of this project over 3,000 tons of CO2e emissions per year have been avoided, with an estimated reduction of more than 35,000 tons of CO2e for the next 10 years. Sugrés has achieved a 29% reduction in coal consumption; 80% overall reduction in production costs; more than 200% increase in brick production increasing to an average of 1700 tons product / month; and a 50% growth in workforce due to increase efficiencies in production. Also, working conditions improved dramatically.

Through USAID’s technical and financial assistance, Sugrés has achieved significant gains in reducing GHG while increasing operational efficiencies. In addition it has increased its capacity to implement additional climate change interventions to reduce its emissions footprint and it is now evaluating other projects to improve heat recovery options that will expand overall energy performance of its brickmaking operations.

USAID’s CCEP Program brings innovative clean alternatives to improve air quality and productive processes to the Colombian brick sector.

October 2015
This publication was produced for review by the U.S. Agency for International Development. It was prepared by the USAID/Colombia Clean Energy Program (Tetra Tech Inc. prime contractor).

U.S. Agency for International Development
www.usaid.gov
B.6  A CLEAN SLATE IN ETHNIC EDUCATION

CCEP, the Antioquia Governor's Office and EPM form an alliance that strengthens education

Colombia has one of the richest legislations in the world to protect indigenous communities. Unfortunately, this legal framework presents many loopholes and shortcomings to protect those meant to serve. Issues like education are usually seen under a Western lens and governments too often ignore traditional knowledge, practices, and leaders. In order to address some of these shortcomings, the Antioquia Governor's Office worked with indigenous leaders to design a strategy that strengthens ethnic-based education in rural settings, known as CERIs - Rural Indigenous Education Centers (Centros Educativos Rurales Indígenas) that combine traditional and 21st century teaching methodologies. Most communities are quite remote and lack the most basic infrastructure, not to mention electric power or basic sanitation.

USAID's Colombia Clean Energy Program (CCEP) formed an alliance with Antioquia Governor's Office and Empresas Públicas de Medellín (EPM) to provide power to communities participating in the CERIs strategy by strengthening the department's ethnic education model and providing the tools needed to facilitate instruction with the installation of solar panels that provide electric power to 14 schools and various community facilities, benefiting 495 people. Parties invested close to USD 400,000 to install solar energy systems, involve traditional leaders and assure consensus-building, resulting in a project that was acceptable, viable and sustainable to community members, project funders, and the environment.

The alliance helped community members see CERIs as education scenarios that respect their traditions. While the Governor's Office and EPM strengthened ethnic education and its linkages to Western knowledge, CCEP trained community members on energy efficient practices and environmental sustainability. Furthermore, USAID's CCEP worked with these two institutions to build a social intervention model they will replicate to work with indigenous communities in the future, creating a sound basis that takes into account community needs in their future development work in indigenous territories.
B. Success Stories Submitted to USAID

B.7 100% Rural Energy for Colombia

CASE STUDY
100% Rural Energy for Colombia

Thanks to USAID’s Colombia Clean Energy Program (CCEP) three departments of the country now have wide-ranging Rural Energy Plans.

CHALLENGE
Although 96% of Colombia’s population is served through the national central electric grid, the remaining 4% which accounts to over 3.5 million Colombians either have poor or no access at all to modern energy services. Most of the people that live in these “electrically unserved” areas come from the rural sector; generally peasants and vulnerable ethnic communities. Though the National Colombian Government (GOC) has for decades undertaken rural electrification programs, and some departments have made interesting advances in policies and actions concerning energy usage and enjoyment, most of them are unprepared not only for guaranteeing quality energy resources for their rural population, but even for planning what to do with the lack of energy in the years ahead.

INITIATIVE
With the leadership of USAID’s Colombian Clean Energy Program (CCEP) in partnership with GOC, the departments of Narino, Guajira and Tolima have designed Departmental Sustainable Rural Energy Plans, termed “PERS” for their Spanish acronym, for the next two decades. The PERS are comprehensive energy and socioeconomic diagnoses of the rural sector, and 15-20 year rural energization strategies for each department’s subregions. The three departments together have a rural population of more than 700,000 people, with significant energy difficulties, and with the great potential of implementing clean energy developments in the future. The PERS were designed in partnership with the Colombia’s Mining and Energy Planning Unit (UPME), the Institute for the Planning and Promotion of Energy Solutions for the Non-Connected Zones (IPSE) and interdisciplinary teams from the Universities of Narino and Tolima, and the National Learning Service Agency (SENA) in Guajira. The wide-ranging PERS initiatives included the development of a participatory process that incorporated local resources and that are sustainable over time.

The success of this strategy is linked to its distinctive methodological approach, which focuses on gathering non-existent and reliable primary data and formulating initiatives with regional impact that incorporate local resources and that are sustainable over time.

ANDRES PANTOJA
PERS Narino University Coordinator

JUNE 2015
This publication was produced for review by the U.S. Agency for International Development. It was prepared by the USAID Colombia Clean Energy Program (TetraTech EE, Inc prime contractor).
U.S. Agency for International Development
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RESULTS
The PERS Narino, the first of these initiatives to be thoroughly designed, received in December 2014 the AMBER award on Research and Development of the Colombian Electricity Sector. It is already under Implementation and has received public funding worth over USD $3 million for its development, which includes detailed studies of clean energy alternatives, and the installation of photovoltaic systems. clean refrigeration solutions and public lighting for rural areas. Guajira and Tolima PERS’ are in their last designing phase and will enter implementation in the second semester of 2015. Moreover, thanks to these advances in the three departments, work has begun for the development of PERS in the departments of Choco and Cundinamarca this year. In this way, USAID is backing up the development of demand-based energy strategies for the Colombian rural sector with the potential to change the lives of vast rural populations in the country.
B.8 ON THE ROAD TO CLEANER PRODUCTION

On the road to a cleaner brick production

On June 5th 2014, USAID signed a Memorandum of Understanding with the Bogota Chamber of Commerce (BCC) and its affiliate, the Environment Business Corporation (CAEM), to promote the adoption of clean technologies and reduce the emission of greenhouse gases in the Colombian brick sector.

The signing ceremony was attended by USAID Chief of Staff (Margaret Sullivan); USAID/Colombia Mission Director (Peter Natiello) and Environment Office Director (Chris Abrams); BCC’s Executive Vice-president (Luz Marina Rincon) and Governance Vice-president (Jorge Mario Diaz); CAEM’s Director (Fabiola Suarez); and representatives from the beneficiary brick industries.

USAID’s Chief of Staff, Margaret Sullivan acknowledged this project as a major achievement of the Mission and the implementing partners in promoting alliances with the private sector and materializing initiatives with concrete and measurable impacts in the environment.

Through this 2-year, USD $1.2M project, USAID, BCC and CAEM are assisting and co-financing 20 small and medium scaled artisanal brick factories located in the departments of Cundinamarca and Boyaca in the replacement of old manual coal feeding technologies used in brick beehive kilns with modern and efficient pulverized coal feeding systems to assure complete combustion, reducing coal consumption, emissions and baking times.

With an estimated reduction potential of 16,700 tons of CO2e per year, this project will have a powerful environmental and economic impact, improving the air quality and living conditions for 120 factory workers and adjacent communities, as well as increasing production, productivity and competitiveness of the participating producers.
USAID supports the development of sustainable rural energization projects to supply energy needs in Nariño.

**CHALLENGE**
Nariño is a predominantly rural department of 1.7 million inhabitants located in southwestern Colombia. With over 50% of its population living in rural and impoverished areas, the department has one of the highest rural and vulnerability indexes in the country. Like other rural communities in Colombia and Latin America, geographic isolation, weak physical and institutional infrastructure and historically rooted socioeconomic inequalities have made access to electricity and other basic services a pressing and unsolved challenge. Currently, 86% of the rural households are interconnected to the grid. However, the government still faces critical hurdles in guaranteeing a permanent flow of electricity for all connected areas, and providing alternative energy solutions for more than 15,000 households, which remain completely deprived of electricity and are located in zones where interconnection is costly and technically unviable. At the same time, the predominance of wood fuel for cooking and electricity consumption primarily for illumination purposes reveals that available energy sources are not being used to stimulate a sustainable rural development path.

**INITIATIVE**
USAID, working with the Colombia’s Mining and Energy Planning Unit (UPME), the Institute for the Planning and Promotion of Energy Solutions for the Non-Connected Zones (IFSE) and an interdisciplinary team from the University of Nariño, supported the design of a 17-year Sustainable Rural Energization Plan (PERS Nariño 2013-2030). This initiative involved the application of geo-referenced surveys in 2,479 rural households, 510 commercial establishments and 136 industries and institutions, which provided key primary information to develop a comprehensive energy analysis and socioeconomic diagnosis of the region, establish localized energy policy guidelines, and propose an innovative methodology for the formulation of economically, technologically, environmentally and socially sustainable productive projects involving the use of clean energy sources.

**RESULTS**
Almost immediately after the completion of PERS Nariño, 4 of the 13 productive projects structured and presented by PERS received public funding worth over USD 3 million for implementation throughout 2014. These projects include a detailed study of clean energy alternatives to benefit 225 families living in off-grid areas with energy coverage below 80%, and the installation of photovoltaic systems, clean refrigeration solutions and public lighting in 6 under-served educational institutions. According to Andres Pantaja, coordinator of the PERS within the University of Nariño, “the immediate success of this strategy is linked to its distinctive methodological approach, which focuses on gathering non-existent and reliable primary data and formulating initiatives with regional impact that incorporate local resources and that are sustainable over time.” Precisely, due to PERS Nariño’s success, the methodology gained the status of national policy in the Renewable Energy Law approved on May 2014, and other PERS are being replicated in Tolima and La Guajira and planned in Chocó, Cundinamarca and Boyacá, as part of a national rural energization strategy for the non-connected zones. Additionally, all project databases and results have been incorporated in the geo-referenced and open platform http://spern.udenar.edu.co/90/siperan/, which provides users and policy planners with high quality information, and integrates the department’s energy supply with its specific productive opportunities.
APPENDIX C  SAMPLES INITIAL WEEKLY NEWS UPDATE

USAID/Colombia Clean Energy Program (CCEP)
Weekly News Update
June 2nd – 6th, 2014

On June 5th, USAID/Colombia and CCEP signed a Memorandum of Understanding (MoU) with the Bogota Chamber of Commerce (BCC) and its affiliate, the Environment Business Corporation (CAEM), to formally start the project “Energy Efficiency for 20 small and medium sized artisanal brick factories in the departments of Cundinamarca and Boyaca”. The signing ceremony was attended by USAID’s Chief of Staff (Margaret Sullivan) and Advisor to the Administrator (Rebecca Levy); USAID/Colombia’s Mission Director (Peter Natiello) and Environment Office Director (Chris Abrams); BCC’s Executive Vice-president (Luz Marina Rincón), Governance Vice-president (Jorge Mario Díaz) and Cooperation Projects Manager (Pilar Alfaro); CAEM’s Director (Fabiola Suárez) and her team (Paola Herrera and Aura Luisa Rodriguez), CCEP’s DCOP (Catalina Alvarez); and representatives from two of the 20

This document was produced for review by the United States Agency for International Development. It was prepared by the USAID/Colombia Clean Energy Program (Tetra Tech ES), prime contractor.
beneficiary brick industries (Arcillas de Colombia and Asociación Nacional de Fabricantes de Ladrillos y Materiales de Construcción – ANAFALCO). USAID’s Chief of Staff Margaret Sullivan acknowledged this alliance as a major achievement of the Mission in promoting partnerships with the private sector to materialize initiatives with concrete and measurable impacts on the environment. Furthermore, apart from its effect on restricting pollutant emissions at a national level, Sullivan emphasized that this project has emerged at a strategic time of “significant breakthroughs regarding the US Government’s commitment to combat climate change”. With the regulations rolled out by the Environmental Protecting Agency (EPA) on June 2nd under the Clean Power Plan proposal to reduce greenhouse gas emissions from coal-fired power plants as much as 30% below 2005 levels by 2030, this project echoes US political efforts and policy guidelines aimed at institutionalizing a binding framework to take actions on global warming.

- This week, CCEP TI and IPSE’s Director (Elkin Eduardo Ramírez), sub Director (Jaime Castiblanco) and engineer (Gloria Parga), discussed the possibility of undertaking new joint RE projects in municipal heads, to be selected from a list of hybrid (solar-diesel) and micro hydro projects previously evaluated and prioritized by IPSE. IPSE has already committed part of its 2014 budget to finance hybrid project designs, which are being developed using the HOMER energy modeling software and may be included in the HOMER training workshop to technical staff of UPME, IPSE, CREG and MME to be held on June 9-12. CCEP and IPSE also discussed the possibility of implementing a MHP project to support a cold chain for dairy production in the community of Santana Ramos (Puerto Rico – Caquetá). Finally, IPSE asked CCEP to explore the possibility of resuming the list of projects requested by the Arhuaco indigenous community in the Sierra Nevada de Santa Marta as a second phase of the “Cordón Ambiental” program. However, CCEP emphasized that in order to be considered, these projects must not lie within a national park area and should be associated to a productive activity that guarantees their sustainability.

- On June 3rd, PERS Nariño’s coordination team (Andrés Pantoja and Dario Fajardo) presented the final results and deliverables of the PERS Nariño project to UPME’s Director (Angela Cadena), IPSE’s Director (Elkin Eduardo Ramírez) and CCEP’s COP (Jose Eddy Torres). One of the main results to be highlighted is that some of the projects formulated and structured using the PERS methodology, such as those comprising the analysis of energy generation with clean energy sources in Nariño, the installation of photovoltaic solutions in several rural educational institutions, and the design...
and implementation of 34 digital farms for autonomous irrigation systems supporting the program “Nariño Vive Digital”, have assured investment budgets for more than USD $3M. This significant outcome ratifies the financial priority given by the GoC through the new RE/EE Law to projects incorporated within Sustainable Rural Energization Plans.

- Within the framework of the Yumbo industrial corridor project, this week, T3 performed a round of field visits to potential companies who had been previously contacted and evaluated by CCEP and who had manifested their interest in participating in the initiative: Cervecería del Valle S.A., Alimentos Finca S.A., Cables de Energía y Telecomunicaciones S.A. (Centelsa), Smurfit Kappa Cartón de Colombia and Italcol Alimentos Concentrados. During this visit T3 presented our Program and the scope of the Yumbo corridor project, observed production plant facilities and requested detailed information on each company’s fuel consumption and production volumes. This data will be analyzed by T3 in order to identify feasible project opportunities.

- In follow up to a meeting held last week (See Weekly News Update May 26-30) with representatives from the Metropolitan Area of Aburra Valley (AMVA, for its acronym in Spanish), this week T3 met with AMVA and Universidad Pontificia Bolivariana (UPB) to present the CCEP Program and to discuss the goals and scope of the upcoming agreement between AMVA and UPB for the reduction of greenhouse gas emissions in the Aburra Valley (Antioquia). As a result of this meeting, UPB agreed to submit a list of the top 15 CO2 emitter industries in the region, which will be evaluated by T3 to identify possible EE project opportunities.
Renewable Energy and Energy Efficiency Enabling Environment

- **Engines are running!** December 18th was the day when we saw the inauguration of the biomass gasification and solar panel systems installed at the Bogota Botanical Garden (JBB). Among colleagues and counterparts, we shared this great moment listening to statements on the project as a clean energy showcase in the drive towards sustainable cities from Luis Olmedo (Director of JBB), Lawrence Rubey (USAID Deputy Mission) and Mabel Ruiz (JBB’s Coordinator for this project); presenting two videos — one for children and the other for grown-ups, academics, engineers, professionals, etc.— about the use of biomass from city tree trimmings as a clean energy source and on the operation of the gasifier; and demonstrating the Garden’s new wood chipper which will provide raw material for the gasifier. At the end of the event, CCEP and JBB held their second clean energy concert – the first being the Sonera Solar concert in 2013 – with the sensational “La 33” salsa band, this time powered by biomass energy. We would like to thank all those who have joined us throughout this setting and implementation process of our “Clean Energy” project.

- **Clean energy hits the economy!** Among the most powerful economic groups in Colombia have joined CCEP and UPME in the technical and financial structuring of eight energy efficiency and renewable energy projects in steel, metallurgical, textile, sugar, candy and paper & pulp manufacturing plants and urban department store chains through our joint PPF mechanism. This week the first PPF contracts were signed between UPME and the four engineering companies hired to take these initiatives to technical certainty and financial closure. The largest of the initiatives has been in the works for 10 months between CCEP, ESCO MGM Innova Energy Services and Carvajal Pulpa & Papel, a sugar-cane bagasse paper
manufacturer, and consists of a USD $15M cogeneration plant from biomass waste, which would potentially reduce 22,000 tons of CO₂ emissions per year. After much study, negotiation and approvals from both boards of directors, a letter of intention was signed by the president of the paper company agreeing to preliminary terms of a 10-year ESCO contract with MGM, depending on the results of the PPF study.

**Expanding Access to Renewable Energy Sources in Off-grid or Under-served Areas**

- At a meeting held on December 15 between EPSA and CCEP, it was determined that EPSA will undertake the soil testing for Punta Soldado and will go to the Regional Environmental Authority (DAR) in order to request the technical environmental permits. With regard to the billing collection mechanisms, a lower-cost alternative to the proposed prepaid meters for Bajo Calima will be incorporated for the disperse solar panel component of the project. EPSA will also request a site visit to the area by the DAR. Moreover, for each of the projects Electric Service Administrative Boards (JASE) are going to be established by EPSA; the required training process will take place. EPSA and its social team will accompany this work. The preparation of final project design spreadsheets was set for February 20th, 2015. As for the projects tracking and monitoring, it was explained what these tasks are about; the responsibilities for this job were also mentioned. CCEP will transfer its M&E methodologies to EPSA for further implementation of projects.

- In pursuance of a second group of indigenous and Afro-Colombian projects to be jointly developed during 2015, CVC was informed on December 16th that, due to new program guidelines, CCEP will implement these projects through subcontracts (request for tenders, selection, hiring, execution and delivery) rather than donations; therefore, the Program will hold its tender process in compliance with agreed contributions. It was suggested holding a meeting the third week of January with Buenaventura Community Councils (ACIVA and ORIVACA) to explain the financial implementation of projects, and to develop project design sheets by January 30th. It was concluded that it is necessary to arrange the technical and environmental visit of CCEP and CVC to Chachajó to assess the options of pico-hydro power versus a biomass gasification plant for that community. CVC also requested assistance for the technical evaluation and the subsequent formulation of an RE project in the rural area of Miraflores (village of Barragán, Municipality of Tuluá), which is a peasant community with 40 scattered dwellings. This project is part of the initiatives that CVC is attempting to deploy from the experience gained with the Program.
## APPENDIX D  CCEP PERFORMANCE INDICATORS CHANGES

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<tr>
<td>GHG emissions, measured in metric tons of CO2 equivalent (CO2e), reduced or sequestered as a result of USG assistance</td>
<td>GHG emissions, estimated in metric tons of CO2e, reduced, sequestered, and/or avoided as a result of USG assistance</td>
<td>GHG emissions, projected for the entire lifetime of projects estimated in metric tons of CO2e, reduced, sequestered, and/or avoided as a result of USG assistance</td>
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<tr>
<td>Number of laws, policies, agreements and/or regulations addressing clean energy (climate change) drafted as a result of USG assistance</td>
<td>Number of laws, policies, strategies, plans, or regulations addressing climate change (mitigation or adaptation) and/or biodiversity conservation officially proposed, adopted, or implemented as a result of USG assistance</td>
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<tr>
<td>Number of laws, policies, agreements and/or regulations addressing clean energy (climate change) adopted by the government as a result of USG assistance</td>
<td>Number of laws, policies, strategies, plans, or regulations addressing climate change (mitigation or adaptation) officially presented to the government as a result of USG assistance</td>
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<td>Number of laws, policies, agreements and/or regulations addressing clean energy (climate change) officially presented to the government as a result of USG assistance</td>
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<td>Number of laws, policies, strategies, plans, or regulations addressing climate change (mitigation or adaptation) officially proposed, adopted, or implemented as a result of USG assistance</td>
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<td>Number of people who now have access to modern energy services as a result of renewable energy technologies through USG assistance</td>
<td>Number of beneficiaries with improved clean energy services due to USG assistance</td>
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<td>Number of institutions with improved capacity to address climate change issues as a result of USG assistance</td>
<td>Number of institutions with improved capacity to address climate change issues as a result of USG assistance</td>
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<td>Number of mitigation and/or adaptation tools, technologies and methodologies developed</td>
<td>Number of mitigation and/or adaptation tools, technologies and methodologies developed</td>
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<td>Number of mitigation and/or adaptation tools, technologies and methodologies tested</td>
<td>Number of mitigation and/or adaptation tools, technologies and methodologies developed</td>
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<td>Number of mitigation and/or adaptation tools, technologies and methodologies adopted</td>
<td>Number of mitigation and/or adaptation tools, technologies and methodologies developed</td>
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## D.CCEP Performance Indicators Changes

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<tr>
<td>Amount of investment leveraged in U.S. dollars, from private and public sources, projected for climate change as a result of USG assistance</td>
<td>Amount of investment leveraged in U.S. dollars, from private and public sources, for climate change as a result of USG assistance</td>
<td>Amount of investment mobilized in USD for climate change as supported by USG assistance</td>
</tr>
<tr>
<td>Amount of investment leveraged in U.S. dollars, from private and public sources, executed for climate change as a result of USG assistance</td>
<td>Clean energy generation capacity installed or rehabilitated as a result of USG assistance</td>
<td>Clean energy generation capacity installed or rehabilitated as a result of USG assistance</td>
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<tr>
<td>Quantity of operational renewable electricity generation as a result of USG assistance, disaggregated by solar, hydro, wind, biomass and mix energy saved due to energy efficiency/conservation projects as a result of USG assistance</td>
<td>Expected lifetime energy savings from energy efficiency or energy conservation, as a result of USG assistance</td>
<td>Clean energy generation capacity supported by USG assistance that has achieved financial closure</td>
</tr>
<tr>
<td>Number of workshops and capacity building activities for national, regional and local level public and private institutions</td>
<td>Number of person hours of training completed in climate change as a result of USG assistance</td>
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<td>Number of participants attending workshops and capacity building activities as a result of USG assistance</td>
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<tr>
<td>Number of CCEP pre-investment activities</td>
<td>Number of CCEP pre-investment activities</td>
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<td>Number of people gaining employment or better employment as a result of the program</td>
<td>Number of people gaining or improving employment, directly or indirectly, as a result of clean energy program interventions</td>
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This Appendix illustrates some of CCEP’s press coverage received throughout the life of the program. This media coverage was positive and helped CCEP to broaden understanding of the concept of clean energy and its associated benefits, particularly to under-served and vulnerable communities, as an integral part and essential element for the country’s development. This media coverage has also contributed to promote the use of clean energy in Colombia and has helped to create awareness and understanding of some initiatives undertaken by USAID and its main partners to promote clean energy in Colombia.

During October 2015 – September 2016 period several notes and articles on CCEP’s projects where published by the national media. Here a selection, with their respective links:

- RCN NOTICIAS broadcast and web page, October 12, 2015: note on CCEP-assisted solutions in Punta Bonita, Clean Energy for Buenaventura
- PORTAFOLIO web page, October 28, 2015: “Esta fábrica de helados bajó de 60% su gasto de energía”
- PORTAFOLIO front page, November 23, 2015: “Reconversión, una ladrillera cambió el carbón por la cáscara de café”
- PORTAFOLIO, December 21, 2015: “La fórmula de c1 jeans para sacar prendas más verdes”
- CARACOL NOTICIAS, May 24, 2016: La Guajira water pumping project presented in Gente que le pone el alma
- MINUTO 30.COM, June 30, 2015: "Con la ayuda de energías renovables se calma la sed de casi 500 familias wayúu
- CONTACTO LATINO, July 1st, 2016: "A pedalazos, comunidades wayús reactivaron pozos de agua"
- COSTA NOTICIAS web page, July 1st, 2016: "Con energía solar y a pedalazos los Wayúu reactivaron pozos de agua"
- EL HERALDO, July 2, 2016: "Con energía solar y pedaleando los wayuu reactivaron pozos de agua", http://www.elheraldo.co/la-guajira/con-energia-solar-y-pedaleando-los-wayuu-reactivaron-pozos-de-agua-269608
During October 2014 – September 2015 fiscal year several notes and articles on CCEP’s projects where published by the national media. Here a selection, with their respective links:

- **Experiment to generate energy with trees in Bogotá** (“El experimento para que árboles generen energía para Bogotá”). December 26, 2014. EL TIEMPO.
- **Solar Energy for Water Pumping in La Guajira** (“Energía solar para sacar agua en La Guajira”). March 3, 2015. PORTAFOLIO.
- Clean Technologies for Wayuu Communities (“Tecnologías limpias para comunidades wayuu”). March 10, 2015. EL HERALDO.
- **Three National Parks are implementing Sustainable Energy systems** (“Tres parques naturales le apuestan al sistema de energía sostenible”). September 16, 2015. EL TIEMPO.
- Three National Parks are implementing Sustainable Energy systems (replica) (“Tres parques naturales en Colombia se abastecerán con energía solar”). September 16, 2015. MINUTO 30.COM.

Some of the projects were also highlighted through CCEP’s internal creative weekly bulletin. Here some examples, with their respective links:

- **Palmor: great example of Clean Energy in Colombia** (“gran ejemplo de energía sostenible para el país”) Comunicación con Energía, August 14, 2015.
E.CCEP In the Media

- **Clean Energy for Punta Bonita (Buenaventura)** (“Energía Limpia... ¡Y bonita!”) Comunicación con Energía, August 21, 2015.
- **Clean Energy Water Well in La Guajira** (“El pozo sí tiene agua”) Comunicación con Energía, September 24, 2015.
APPENDIX F  CCEP VIDEO AND PHOTOGRAPHY

During FY 2016, CCEP produced a series of videos and photographs, available in the redesigned website:

Photos:
- Palmor is Energy;
- Guajira Power;
- Clean Energy for “El Yucal”;
- Energy with very high degrees of temperature;
- Energy with very low degrees of temperature.

Videos -- CCEP filmed and produced several high-definition videos:
- CE solutions and EE experiences in two companies that participated in T3 projects in Antioquia and Caldas. The video is titled "Energy at Very High and Low Degrees.
- Video documentary of the solar and mechanically-assisted water pumps in La Guajira, a project implemented in alliance with FCGI, presented during project inauguration. The video documentation was filmed during more than one year and showcases the conditions before, during, and after project implementation of the solar and mechanically assisted water pumps in 38 sites in La Guajira. https://youtu.be/ROa9PIU-Cuo
- Video documentary of the hybrid solar/diesel power project in Punta Soldado, in alliance with EPSA. The video documentation was filmed upon project completion and presents testimonies of how living conditions and education opportunities improved once the project was completed. https://youtu.be/-O3zXNJQJ8ag

Latest videos available through the USAID/Colombia YouTube Channel:
- PuntaSoldadoFeb24 - https://youtu.be/bICgo6Jfx5A
- PuntaSoldadoFeb24ENG -https://youtu.be/-qGHCbIspC8
- PalmorUSAID Enero20 - https://youtu.be/-FQrNjknq0A
**APPENDIX G CLEAN ENERGY SPONSORED EVENTS**

**Solar Concert – 2013.** CCEP organized the first solar powered concert in Colombia. The “SonEra Solar” in the Bogotá Botanic Garden gathered 2,800 people and had a huge media response and coverage. The public at the Concert learned about solar technology and witnessed its efficiency, while enjoying and dancing to the rhythm of Conector, Richard Blair and Javiro. The Wapapura team was in charge of conducting the solar powered video recording of the event.

**Bogota Green Race- February 2016.** The event, organized by Fundación Natura with the support of the United States Embassy, gathered more than five thousand professional and amateur athletes. With USAID support, CCEP prepared and organized a CE demonstration site for the Environmental Fair, previous to the race, and the day of the race. The site included an exhibit stand powered by solar energy and refreshments cooled by appliances using solar power.

**Medellin Primavera Fest – May 2016.** - CCEP participated and sponsored two interactive exhibits featuring power generated by bicycles. Pedaling with the DJ (Pedaleando con el DJ) required participants to use a stationary bicycle to produce sufficient energy to power lights and DJ equipment playing music. The bike also charged cellphones and was the only charger available at the fair, as no electric plugs were available for the public on site. Medellín by Bike (Medellín en bici) was a miniature city display with an electric cycling trail connected to four bicycles that participants used to "race" around town.