



PROJECT IDENTIFICATION FORM (PIF)

PROJECT TYPE: Medium-Size Project

TYPE OF TRUST FUND: GEF Trust Fund

PART I: PROJECT INFORMATION

| | | | |
|---|--|---------------------------|---------------|
| Project Title: | Promotion of industrial energy efficiency in Colombian industries | | |
| Country(ies): | Colombia | GEF Project ID: | 5828 |
| GEF Agency(ies): | UNIDO | GEF Agency Project ID: | 140122 |
| Other Executing Partner(s): | Mining and Energy Planning Unit (UPME) Administrative Department for Science, Technology and Innovation (Colciencias) | Submission Date: | 30 April 2014 |
| | | Resubmission date | 6 June 2014 |
| GEF Focal Area (s): | Climate Change | Project Duration (Months) | 36 |
| Name of parent program (if applicable): | | Project Agency Fee (\$): | 160,788 |

A. INDICATIVE FOCAL AREA STRATEGY FRAMEWORK:

| Focal Area Objectives | Trust Fund | Grant Amount (\$) | Co-financing (\$) |
|-----------------------|------------|-------------------|-------------------|
| CCM-1 | GEFTF | 226,000 | 3,000,000 |
| CCM-2 | GEFTF | 591,500 | 500,000 |
| CCM-2 | GEFTF | 875,000 | 3,500,000 |
| Total Project Cost | | 1,692,500 | 7,000,000 |

B. INDICATIVE PROJECT DESCRIPTION SUMMARY

| Project Objectives: Strengthen the technical and financial capacities of relevant stakeholders to enable the scale up of the energy efficiency measures which have been piloted by nationally driven programmes | | | | | | |
|---|------------|---|--|------------|-------------------|------------------|
| Project Component | Grant Type | Expected Outcomes | Expected Outputs | Trust Fund | Grant Amount (\$) | Cofinancing (\$) |
| 1. Standards and Technical Regulations | TA | The national institutions develop the mandatory regulations, voluntary standards and M&V schemes to support the adoption of energy efficiency in industries | 1.1 Revision of the legal EE framework, focused on technical regulations for labeling of boilers 1.2 Awareness raising and dissemination of technical regulation amongst users 1.3 National energy implementer and energy auditor certification schemes are defined, and institutions which can assess conformity are identified 1.4 Piloting of the personnel certification programme is made, focusing on trainees from the "Comprehensive Energy Management System" (CEMS) | GEFTF | 190,000 | 500,000 |

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|--|-----|---|---|-------|---------|-----------|
| | | | 1.5 Design of a Monitoring and Verification (M&V) scheme for EE measures | | | |
| 2. Scale up the programme "Integrated Energy Management System" (IEMS) to national level (managerial and technical skills) | TA | The development of specific capacities in industries is promoted, establishing a cadre of highly specialized energy management experts from the public and private sectors; which are available as a long-term technical resource to industry and the country. | 2.1 A dedicated training on energy management for 200 enterprise managers and financial managers | GEFTF | 345,000 | 1,100,000 |
| | INV | | 2.2 50 EE professionals received EnMS implementer level training, which includes classroom and practical training (practical training results in the implementation of EnMS in 50 enterprises) | | 200,000 | 2,000,000 |
| | | | 2.3 Scale up of the CEMS to selected manufacturing regions and industrial subsectors. | | | |
| | | | 2.4 The awareness of 500 industrial entities of new regions/sectors on energy management systems is raised | | | |
| | | | 2.5 At least 150 entities implement and develop Energy Management plans | | | |
| 3. Transfer of system optimization technologies | TA | Demonstrated and measured energy savings in industrial entities through application of system assessment techniques by trained experts, leveraging additional energy savings as more industrial facilities will seek the implementation of systems optimization | 3.1 System optimization training and web-based tools are developed | GEFTF | 617,500 | 1,000,000 |
| | | | 3.2 75 EE professionals received implementer level system optimization training (25 for each type of system: motors, steam and pumps) | | | |
| | | | 3.3 M&V systems are applied to selected enterprises | | | |
| 4. Promotion of financial mechanism for investment promotion at enterprise level | INV | A national financing scheme for EE measures is designed and piloted | 4.1 45 in-depth energy system assessments are completed in manufacturing facilities (15 for each type of system, motors, steam and pumps) | GEFTF | 170,000 | 2,000,000 |
| | | | 4.2 An investment mechanism is designed, in which the capacity of Financial Institutions is raised to better assess energy efficiency projects, and establish dedicated loan schemes and investment opportunities in the enterprises which identify | | | |

| | | | | | | |
|------------------------------|----|---|---|-------|-----------|-----------|
| | | | measures to improve their energy performance 4.3 A portfolio of investment projects is created with the projects identified in the activities of components 2.4 and 4.1 4.4 The investment mechanism piloted to finance measures from the portfolio | | | |
| 5. Monitoring and Evaluation | TA | A robust mechanism for the monitoring and evaluation is put in place to ensure the attainment of project outcomes | 5.1 The project monitoring plan is designed and executed 5.2. Final project evaluation is conducted 5.3 As part of the terminal evaluation follow-up actions, recommendations are determined for long term project sustainability | GEFTF | 60,000 | 100,000 |
| Subtotal | | | | | 1,582,500 | 6,700,000 |
| Project Management Cost | | | | GEFTF | 110,000 | 300,000 |
| Total Project Cost | | | | | 1,692,500 | 7,000,000 |

C. INDICATIVE CO-FINANCING FOR THE PROJECT BY SOURCE AND BY NAME IF AVAILABLE, (\$)

| Sources of Cofinancing | Name of Cofinancier | Type of Cofinancing | Amount (\$) |
|--------------------------|--|---------------------|------------------|
| National government | Mining and Energy Planning Unit (UPME) | In cash | 200,000 |
| National government | UPME | In kind | 800,000 |
| National government | Administrative Department for Science, Technology and Innovation (Colciencias) | In cash | 2,000,000 |
| National government | Colciencias | In kind | 100,000 |
| Private Sector | Colombian Entrepreneurial Development Bank (Bancoldex) | In cash | 3,100,000 |
| Private Sector | National Business Association of Colombia (ANDI) | In cash | 440,000 |
| GEF Agency | UNIDO | In cash | 60,000 |
| GEF Agency | UNIDO | In kind | 300,000 |
| Total Cofinancing | | | 7,000,000 |

D. INDICATIVE TRUST FUND RESOURCES (\$) REQUESTED BY AGENCY, FOCAL AREA AND COUNTRY

The proposed project is for a single focal area, single country, single GEF Agency and single trust fund.

E. PROJECT PREPARATION GRANT (PPG)

Please check on the appropriate box for PPG as needed for the project according to the GEF Project Grant:

Amount Agency Fee
Requested (\$) for PPG (\$)

- (up to) \$ 100K for projects up to & including under \$ 3 million 25,000 2,375

PART II: PROJECT JUSTIFICATION

A. PROJECT OVERVIEW

A.1. Project Description.

1. Global Environmental Problem

Energy intensity in the Colombian economy was of 0,380 barrels of oil equivalent (boe) per USD 1,000. In 2011, energy consumption was 1,100,042 Terajoules, with the industrial sector representing 25.1% of the national energy consumption (UPME 2012). The subsectors with the major consumption are Food, Beverage and Snuff; Cement and Chemicals. In the industrial sector, it has been identified that significant energy saving opportunities that represents about 25% of national energy consumption could be achieved. In an assessment of technical saving potentials, the main opportunities are as follows: 25% savings for heat transfer, 27% for steam generation and 28% for motor systems. Electricity demand is anticipated to grow 3.9% yearly in the 2010-2020 period.

Colombia's energy efficiency policy is defined in the law 697 of 2001 on rational use of energy, which recognizes the efficient use of energy as a matter of social, public and national interest. This law has also established the Programme for the Rational and Efficient Use of Energy (PROURE) which promotes the implementation of energy efficiency measures throughout the energy supply chain. This law has been regulated by decrees 3683 of 2003 (amended by decree 2688 of 2008) 2501 and 2007 which set special provisions for the adoption of energy efficiency measures. These provisions include the creation of an Intersectoral Commission for the Rational and Efficient Use of Energy¹ (CIURE) as an advisor to the Ministry of Mines and Energy body for decision making in the field.

A key milestone in the development of EE regulation was the issuance of Resolution 180919 of 2010 by which the Ministry of Mines and Energy adopted the 2010-2015 action plan to implement the PROURE. The action plan defines specific subprogrammes, priority activities and targets. To achieve the goals contained in the Action Plan, the federal government has promoted cross actions associated with institutional strengthening; formal education at all levels; issuance of technical regulations; design and implementation of financial schemes for the implementation of projects, obtaining resources from international cooperation and regulation of tax incentives for equipment and machinery for energy efficiency projects.

In the climate change context, Colombia has identified that energy efficiency measures are a key action, which is manifested in their National Appropriate Mitigation Actions and also their Low carbon development strategy (ENDBC - 2012), as detailed out in section B.1 Climate Change Policy.

Additionally, the government has executed numerous sectoral actions such as promoting energy efficiency in end uses in each sector, implementation of energy efficiency projects in buildings that proposed technical regulations for energy efficiency in social housing and performed energy audits in public institutions and implementation of the program on energy management in industry, amongst others. A thorough description of the details on the national policy in sectoral actions is presented in Annex A.

In spite of these efforts, concrete implementation remains elusive and hardly any requests have been submitted for fiscal incentives. Awareness and uptake by industries has been very limited.

¹ The Commission is responsible for the efficient use of energy and the adoption of other "non-conventional" energy sources. National law on rational use of energy (n 697 from 2001) established that non-conventional energy sources (NCES) for Colombia are: solar, wind, biomass, small hydro power (< 10 MW), geothermal, marine and nuclear

2. Baseline scenario and baseline project

The following section describes for each relevant aspect the baseline status, the barriers for the adoption of measures or policies and the baseline project scenario.

Policy and institutional aspects

Baseline Status (current activity)

In addition to the detailed policies, strategies and action plans, the government has focused on the development of technical regulation on energy efficiency for electrical installations, lighting and buildings. The development of technical regulations for industrial equipment has been limited in spite of the large potential for energy savings associated to motors and boiler equipment. At the voluntary level, the adoption of an Energy Management Systems (EnMS) has been promoted.

A national programme denominated "Comprehensive Energy Management System" (CEMS)² was established to raise awareness, train and disseminate EnMS. It achieved substantial results during its four years of execution: more details are presented in Annex A.

Barriers

- Efforts on energy efficiency adoption have been initiated by the Government, but support mechanisms are required to strengthen the programmes
- Lack of mechanisms to effectively monitor and verify the results achieved by projects adopted at enterprise level, result in limited data for policy analysis.
- There are no official records or mechanisms that allow monitoring of the impacts of neither the action plan of the PROURE nor the achievement of its goals.

Baseline projects

A new programme called "Consolidation of the Knowledge Network in Energy Efficiency" (RECIEE) will be implemented between 2013 and 2016 and will promote research activities in the field of energy efficiency as well as the implementation of additional pilots of EnMS in enterprises. The programme will further strengthen the network of universities providing education in energy efficiency.

Industrial energy management

Baseline Status (current activity)

As a result of the CEMS project wide dissemination and training (educational) efforts on Energy Management Systems have been conducted but a limited number of implementation (see results in Annex A) occurred in enterprises.

Barriers

- Energy efficiency is not a core interest for most industries and company strategies tend to focus on output growth rather than cost management. Most industries have a budgetary disconnection between capital projects (equipment purchases) and operating expenses (energy and maintenance), therefore, purchasing decisions are based normally on initial capital investment consideration, rather than on operating costs.
- Technology aims to support production, and production practices can have a significant impact on operational efficiency. These practices, however, are usually outside the control of the facility engineers
- Industries do not have a culture of energy and resource management

² Detailed information on the programme, denominated *Sistema de Gestion Integral de la Energia (SGIE)*, is available on the project website <http://www.si3ea.gov.co/> (in Spanish only)

- Mismatch between the trained implementers and the enterprises, resulting in a high number of trained practitioners but very limited number of implemented projects
- Limited practical capacity of trained implementers, as training is academic focused rather than practical training
- Limited geographical outreach, focused only on 5 regions

Baseline project

The “Consolidation of the Knowledge Network in Energy Efficiency” (RECIEE) programme will be implemented by Colciencias and the UPME shall determine the energy performance and technological capabilities of 50 enterprises, and encourage these enterprises to seek certification in ISO 50001, with a target of 25 of them attaining this goal.

Systems optimization approaches

Baseline Status (current activity)

In the action plans, the national government identified key technologies that may achieve energy savings which include: promoting the replacement of conventional motors for high efficiency motors and the use of residual heat recovery in combustion processes.

The Promotion of Market Opportunities for Clean Energy (OPEN) has promoted best operational practices and operational control measures but has not emphasized the use of systems approaches.

Barriers

- Facility engineers tend to focus on components, not on systems. When processes and equipment change over time, inefficiencies in terms of energy use compound and reoccur. Even were systems optimization is available, knowledge resides with the individual who has been trained and is often not institutionalized.
- There is a need to build capacities in data monitoring, reporting, and its analysis; energy management systems, and systems optimization
- Enterprises do not have measurement systems for the consumption of energy (both electrical and thermal) which may support their efforts in determining their energy performance.
- There is limited information about available options, best practices, benchmarks and related financing mechanisms and options

Baseline projects

There is recognition of the importance of adopting more efficient equipment, such as industrial motors, but no awareness of systems approaches. Enterprises are likely to invest in equipment replacement, supported by fiscal incentives. However, significant energy efficiency gains at low cost would not be achieved unless the mechanisms are better disseminated and enterprises awareness of these measures is raised.

Financing mechanisms:

Baseline Status (current activity)

One of the crosscutting strategies of PROURE is to stimulate the market for energy efficiency services. This strategy includes key actions such as the design and development of financial schemes and the implementation of incentives for energy efficiency (further details presented in Annex A)

The three actions have been taken forward in the industrial sector with different results

For example, the Promotion of Market Opportunities for Clean Energy (OPEN) was implemented and raised awareness on the energy service companies (ESCO) model amongst enterprises and EE service provider but failed to create a market for EE services.

A fiscal incentive for enterprises who adopt EE is in place since 2012, but a limited number of applicants have made use of the benefit. Only 29 projects have been technically cleared by UPME to date, with 11 to utilize waste heat from combustion processes and 2 to substitute motors for ones with high energy efficiency.

Barriers

- The government incentives to encourage energy efficiency have had a limited impact.
- The private sector financing schemes offered by banks and second tier institutions supported by own resources and international development banks (IADB, IFC) have not been attractive to enterprises.
- Enterprises have insufficient technical knowledge to adopt measures to save energy.
- There is lack of confidence from the enterprises to develop projects through the ESCO model
- Decisions on EE project investments are based only on conventional energy audits and centered on equipment replacement

Baseline projects

Submission of requests will remain limited due to the lack of incentives provided, resulting in small amounts of investments being made to adopt EE measures by enterprises. The existing offer of financing services provided by private and public banks will be available yet enterprises are unlikely to apply for them.

3. Proposed alternative scenario

The proposed project shall strengthen the technical and financial capacities of relevant stakeholders to enable the scale up of the energy efficiency measures which have been piloted by nationally driven strategies; and will address the barriers described in this section by implementing the following measures:

- *Policy and institutional:* the national institutions develop the mandatory regulations, voluntary standards to support and M&V schemes to monitor their progress;
- *Industrial energy management:* the development of industry specific capacities is promoted, establishing a cadre of highly specialized energy management experts from the public and private sectors; which are available as a long-term technical resource to industry and the country;
- *Systems optimization approaches:* demonstrated and measured energy savings in industrial entities through application of system assessment techniques by trained experts, leveraging additional energy savings as more industrial facilities will seek the implementation of systems optimization; and
- *Financing mechanisms:* a national financing scheme for EE measures is designed and piloted, creating an environment in which financial institutions (such as those listed as cofinanciers) have the interest to provide financing to EE project while at the same time enterprises have the ability to submit suitable bankable business projects. The investment mechanism will be twofold, first it shall support FIs in their assessment of energy efficiency project and second it shall aim to attract FIs which would consider establishing dedicated loans schemes to promote investment opportunities in the enterprises identified under this programme.

4. Incremental Cost Reasoning

The proposed project has 5 components, which have specific outcomes:

1. Policy and institutional national institutions develop the mandatory regulations, voluntary standards to support and Monitoring & Verification schemes to support the adoption of energy efficiency in industries
2. Industrial energy management development of industry specific capacities is promoted, which include implementation of energy management systems under ISO 50001

3. Systems optimization approaches demonstrated and measured energy savings in industrial entities through application of system assessment techniques by trained experts, leveraging additional energy savings as more industrial facilities will seek the implementation of systems optimization
4. Financing mechanisms as a national scheme to promote EE measures is designed and piloted
5. Monitoring and evaluation A robust mechanism for the monitoring and evaluation is put in place to ensure the attainment of project outcomes

The description of the planned activities required to achieve the project outputs is presented in the following table:

| Outcomes | Outputs | Activities |
|-------------------------------------|--|---|
| Policy and institutional | 1.1 Revision of the legal EE framework, focused on technical regulations for labeling of boilers 1.2 Awareness raising and dissemination of technical regulation amongst users 1.3 National energy implementer and energy auditor certification schemes are defined, and institutions which can assess conformity are identified 1.4 Piloting of the personnel certification programme is made, focusing on trainees from the "Comprehensive Energy Management System" (CEMS) 1.5 design of a Monitoring and Verification (M&V) scheme for EE measures | Drafting of regulations based on international and national standards Technical regulation users (enterprise, certification bodies, vendors) receive awareness raising training Identification of certification bodies who may assess conformity of personnel certifications Definition of job task analysis for EnMS implementers and auditors based on best international practices Dissemination of certification schemes amongst graduates from Energy Management Diploma courses with support of University networks Establishment of accreditation schemes |
| Industrial energy management | 2.1 A dedicated training on energy management for 200 enterprise managers, financial managers and financial controllers 2.2 EnMS Training and web based tools developed; 50 EE professionals received EnMS implementer level training, including implementation in 50 enterprises 2.3 Scale up of the IEMS to selected manufacturing regions and industrial subsectors. 2.4 500 industrial entities of new regions/sectors are made aware of energy management systems 2.5 At least 150 entities implement and develop Energy Management plans | Business managers receive EnMS awareness training Plant engineers receive user training Selection of trainees to become implementers and facilities for demonstrations Trainees receive implementer level training and work with enterprise staff to design Energy Management plans as part of their applied training Enterprises adopt Energy Management plans and implement EnMS |

| Outcomes | Outputs | Activities |
|--|---|--|
| Systems optimization approaches | <p>3.1 System optimization training and web-based tools are developed</p> <p>3.2 75 EE professionals received implementer level system optimization training (25 for each type of system: motors, steam and pumps)</p> <p>3.3 M&V systems are applied to selected enterprises</p> | <p>Plant managers receive SO awareness training</p> <p>Plant engineers receive user training</p> <p>Vendors & Associations, promoting systems message, participating in training</p> |
| Financing mechanisms | <p>4.1 45 in-depth energy system assessments are completed in manufacturing facilities (15 for each type of system, motors, steam and pumps)</p> <p>4.2 An investment mechanism is designed, in which the capacity of Financial Institutions is raised to better assess of energy efficiency project, and establish dedicated loans schemes to investment opportunities in the enterprises which identify measures to improve their energy performance</p> <p>4.3 A portfolio of investment projects is created with projects identified in the activities of components 2.4 and 4.1</p> <p>4.4 The investment mechanism piloted to finance measures from the portfolio</p> | <p>Plant assessments, project systems development, case studies</p> <p>Awareness raising and training for Financial institutions</p> <p>Bankable business plan and project preparation</p> <p>Investments in energy efficiency systems optimization projects</p> |

The initial selection for industrial sub-sectors will be to support the energy-intensive manufacturing and agro processing sectors under the government strategic sectors programmes known as Productive Transformation Programme (PTP) which includes steel making and metal forging; paper and printing; vehicle and auto parts; textile and leather; palm oil processing; food and beverage

The regions to be targeted under this programme will be different from those in which the CEMS programme was implemented in order to avoid replication; potential industrial regions include:

- Risalda and Caldas departments, which concentrate machinery, electrical equipment, food and beverage, chemical and papers industries;
- Boyaca and Cundinamarca departments, which has large energy intensive industries in the cement, steel and forging sectors; and
- North Santander department, which has ceramic and clay derived industries.

5. Global environmental benefits: direct emission reductions

Based on the projected energy growth indicators and the national EE targets from PROURE, it is estimated that that the direct-project emission reductions to be expected from the project are of 261,673 tCO₂. The full

calculation is presented in Annex B. The post project and indirect benefits shall be estimated in full detail in the GEF CEO Endorsement Form including the Climate Change tracking tool.

With regards to social benefits the project has a strong capacity building aspect which shall improve national skills on an industrial manufacturing as well as improving the design of national equipment. Furthermore, efforts will be made to mainstream gender issues by sensitizing relevant stakeholders on the importance of gender issues and their relationship with capacity building projects in the technical field.

A detailed analysis is planned for the project design; collecting the relevant gender data available. A key indicator relevant to project is the impact of improving technical capacities for females.

6. Innovativeness, sustainability and scale up potential

Innovation

The proposed project strengthens capacity in selected technical fields by creating a pool of trained implementers of EnMS and systems optimization measures from the public and private sectors which will be available as a long-term technical resource to industry and the country:

- **Systems optimization.** The presence of energy-efficient components in industrial systems is important but provides no assurance that energy savings will be attained if the system is not properly designed and operated. Evidence from implemented national and international programmes shows that, while efficient components may bring about gains in the range of 2 to 5 percent, systems optimization measures can attain average efficiency gains of 20 to 30 percent with a payback period of less than 2 years. The implementation of system optimization measures requires specific technical knowledge, consistent monitoring and remedy action by the industry.
- **Energy Management systems (EnMS):** the adoption and promotion of national energy management standards, along with capacity building of enterprises and institutions will be effective in transforming the national industrial energy efficiency market condition. Experiences in national and international industrial energy efficiency projects have shown that maintaining energy efficient practices is a challenge in industry: most optimized systems lose their initial efficiency gains over time due to personnel and production changes. By implementing energy management systems industrial facilities are equipped with tools which assist them in integrating energy efficiency and system optimization into their daily management. EnMS provide structured and comprehensive guidance on how to establish closer linkage between business practices for the management of energy and core industrial values of cost reduction, increased productivity, environmental compliance and global competitiveness. Standardized EnMS have the additional value of being an instrument for global recognition of good practices

These measures can be characterized under the “National Science, Technology and Innovation System” (established under law 1286 of 2009), which defines within its scope all actions that support the promotion of increased productivity and national competitiveness” (see Annex A for more details). Colciencias, the national administrative department responsible for this project acknowledges this intervention as within the innovation system, and hence is a main executing partner and cofinancier to the project.

Sustainability:

The sustainability of the measures implemented by industrial facilities is based on the adoption of Energy Management systems, which imply a change in the operational and managerial culture of a firm. Through its linkage with the certified EnMS, ISO 50001, the project builds on a regular auditing process, which assures that proper and efficient operation of industrial energy system is maintained and becomes part of each firm’s operating culture. The combination of a national energy management standard with tools and training will allow companies to integrate industrial energy efficiency projects/investments into management structures, such as the ISO Standard, that provide for planning, process documentation, independent verification, and continual improvement.

The key measures that will ensure sustainability of the intervention are:

Conformity assessment of ISO 50001 – standards as a voluntary policy measure: when adopting standards, enterprises need to have confidence in the results to be derived from their implementation and recognize a market value if they decide to certify their management system against the ISO 50001 standard. The project seeks to create personnel certification schemes for both implementer and auditors of EnMS. Establishing this merit based recognition system will create trust in the service providers which enterprises will use for both implementation and conformity assessment.

Financing: a financial scheme is piloted in enterprises using funding from financial institutions, establishing a practice which is replicable for future investment.

Therefore, the combination of an improved regulatory framework, financial incentives, intensive market stimulation, and the robust quality infrastructure supporting the adoption of EnMS will results in a long-term sustainability of the project measures.

Scaling-up:

The project is built on the basis of the results of the CEMS and the OPEN projects:

- The CEMS raised awareness on energy management to managers of large industries implement and created a significant pool of graduates in energy management in selected regions; and
- The OPEN piloted measures which demonstrated Best Energy Operational Practices focused on Bogota.

The two initiatives resulted in significant improvements of the understanding of energy management issues and generated important demonstration effects but failed to consolidate a market and a new energy management. Neither of the two projects had national outreach.

First, the proposed project shall scale-up the results of prior initiatives by progress from a pilot stage to a “critical mass “of enterprises adopting EnMS. This will be achieved by building specific capacities in the adoption of EnMs, working with both enterprises and implementers, by providing a practical rather than theoretical approach. Second, the project shall consolidate national energy efficiency by aligning the credit line offer of financing institutions and enterprises needs; leading to replicability and sustainability throughout the country. Finally, the project shall focus its effort in regions which were not addressed by the CEMS programme.

A.2. Stakeholders

| Stakeholders | Roles and responsibility |
|--|--|
| Planning Unit from Ministry of Mines and Energy (UPME) | Main counterpart who has the execution responsibility to adopt energy related policy programmes at national level |
| Administrative Department for Science, Technology and Innovation (Colciencias) | Counterpart who has the execution responsibility to adopt science, technology and innovative policy programmes at national level. Has led the execution of the first phase of the Comprehensive Energy Management System" (CEMS) and is responsible for the second phase |
| National Accreditation Body (ONAC) | Has the role to accredit the competence of certification organizations that will assess conformity of both enterprises and personnel in Energy Management Systems |

| | |
|--|--|
| Knowledge Networks formed by national Universities | Supporting the development of all the activities regarding the training and implementation on the enterprises. Have executed the first phase of the "Comprehensive Energy Management System" (CEMS) and contribute to its second phase |
| National enterprises | Direct beneficiaries that will adopt energy efficiency measures |
| National business association of Colombia (ANDI) | Represent direct beneficiaries, having a normative support role and the ability to disseminate knowledge amongst its member enterprises |
| National public and private financing institutions | May provide financing to industrial beneficiaries who adopt measures, and will receive training to evaluate energy efficiency projects |
| National trainees (individuals) | Direct beneficiaries who will be trained by the UNIDO international experts |

A.3 Indicate risks

The main risks to the effective implementation of the proposed GEF project are described in the following table:

| Risk | Rating* | Mitigation |
|--|---------|---|
| Successful implementation of standards and technical regulations | L | The Energy Management system standard is a voluntary standard which has been adopted in Colombia and requires further promotion for its adoption. The technical regulations on boiler and motors are instruments that will support enterprises in their selection of more energy efficient equipment. However, since the main goal of the project is to adopt better operational parties it does not affect the achievement of the outcomes. |
| No immediate demand of services for trained experts | M | The integrated approach adopted by the project is expected to mitigate this risk by combining the expert training program with factory training in order to create interest in the services that the new national experts will provide. Also, the practical skills resulting from the expert training will meet the market need by assisting industries to prepare for ISO 50001 compliance and by identifying immediate opportunities to improve energy efficiency in systems, thus increasing the productivity of existing system assets. |
| Demonstration projects are delayed, limiting the opportunity to disseminate success stories and develop case studies | L | Factories selected as demonstration sites for the expert-level training will be carefully screened for management support for implementation of the resulting recommendations. These factories are anticipated to provide the initial case studies and thus serve as examples for other factories. The costs of operational improvements resulting from the implementation of an energy management plan are typically small. Likewise, system optimisation projects typically have very attractive paybacks and require modest investments. Both types of improvements frequently have other benefits – such as reduced maintenance or less product waste. The opportunity to approach both energy management and system optimization incrementally with early small successes creates highly favourable conditions for implementation. |
| Lack of coordination between various partners involved in other EE programmes | L | Proper coordination will be sought through the Project Steering Committee and ad-hoc working groups per sector or theme can be set up as needed, bringing in other partners and beneficiaries |

| | | |
|---|---|---|
| Only a few companies make use of ISO 50001 | M | There will be competitive pressures outside of the project to conform to ISO 50001 in order to participate in some attractive export markets. By creating a cadre of experts to assist Colombian industry in achieving this goal, the project offers participants a competitive advantage |
| Incentive and financial support systems are insufficient, especially for SMEs | L | Financial institutions will be encouraged to learn more about industrial energy efficiency savings potential; and companies will be made aware of the financing opportunities through the creation of a portfolio in output. 4.3 |
| Vulnerability to climate events | L | The type of interventions to be undertaken in this project (demonstration and diffusion measures) has negligible vulnerability to climatic events. |

* L = low risk; M = medium risk; H = high risk

A.4. Coordination

In addition to the government led initiatives and the GEF funded project focused on EE described in Annex A, the proposed project has taken into consideration during its design the existing or completed projects in the Colombia/GEF portfolio to avoid duplication and to identify potential synergies for collaboration. Such initiatives include

Mechanism for Voluntary Mitigation of Greenhouse Gas Emissions in Colombia

This IADB/GEF project (GEFID 4135, 2011-2012) aims to formulate and establish the technological and institutional platform basis for a verified emission reductions (VERs) market mechanism and to facilitate efforts of voluntary mitigation of greenhouse gas (GHG) emissions in Colombia. This project is considered as a potential mechanism to promote investments in EE projects, but since its scope differs significantly from the proposed project, no evident overlap is anticipated.

B. DESCRIPTION OF THE CONSISTENCY OF THE PROJECT WITH:

B.1 National strategies and plans or reports and assessments under relevant conventions, if applicable

The use of fiscal incentive to support EE in the industrial and transport sector as well the promotion of NCES is aligned to the following national priorities:

Low carbon development strategy (ENDBC - 2012)

This initiative during 2013 has identified the following elements which are in line with the proposed project:

- Emission reductions in the industrial sector as a priority area, through the technology needs assessment (TNAs) processes and
- Identified National Appropriate Mitigation Actions (NAMAs) under development for urban development and transport, for renewable energy in decentralized areas and for energy efficiency in industry. Moreover, this project becomes a crossover support tool for the formulation and implementation of NAMAs in the industrial sector as it facilitates the characterization of energy consumption by processes.

Programme for promotion of the rational and efficient use of energy (PROURE – 2010-2015)

The joint 2012-2015 targets for EE and NCES agreed by MESD and MME were derived from the targets of the PROURE, as described in Annex A.

Second national climate change communication: The major policies related to climate change mitigation have been made by the national government such as the Programme for the Sound and Efficient Use of Energy presented (PROURE).

The proposed project was identified at the end of the GEF 5 cycle; however, energy efficiency is a thematic area that had been considered in the portfolio planning exercise. Projects were first promoted in other economic sectors which represent a higher share of the energy use in the economy such as buildings.

B.2. GEF focal area and/or fund(s) strategies, eligibility criteria and priorities

This project is in line with the following GEF focal areas

| | | |
|---|---|--|
| <i>CCM-1 Technology Transfer: Promote the demonstration, deployment, and transfer of innovative low-carbon technologies</i> | Outcome 1.2: Enabling policy environment and mechanisms created for technology transfer | Output 1.1: Innovative low-carbon technologies demonstrated and deployed on the ground |
| <i>CCM-2: Energy Efficiency: Promote market transformation for energy efficiency in industry and the building sector</i> | Outcome 2.1: Appropriate policy, legal and regulatory frameworks adopted and enforced | Output 2.1: Energy efficiency policy and regulation in place |
| | | Output 2.3: Energy savings achieved |

B.3 The GEF Agency's program (reflected in documents such as UNDAF, CAS, etc.) and Agencies comparative advantage for implementing this project:

The project is fully in line with Colombia's 2008-2012*3 UNDAF, being relevant to Output 2.2. "Increased national capabilities to develop competitive and sustainable productive processes that take into account regional characteristics and comparative advantages"; and in particular to output 58 "Government and business sectors have improved capabilities to design strategies, programs and projects to promote the efficient use of energy and entrepreneurial efficiency". It is also in line with UNIDO's Country Programme for Colombia which details as one of UNIDO's services in the country to offer support to the Government in the transfer and uptake of energy-

³ Currently under revision

efficient and low-carbon technologies. The regional office supports the execution of ongoing national projects in Colombia in the fields of supply chain development, metrology and conformity assessment as well as environmental management.

The GEF council document EF/C.31/rev.1 illustrates the comparative advantage of UNIDO in capacity building and technical assistance. UNIDO has significant experience in formulating and implementing industrial energy efficiency projects.



UNIDO is currently implementing the Industrial Energy Efficiency in Ecuador (GEF ID 4147) with a similar scope to the proposed project, focusing also on energy management standards and application of systems optimization. The successful results of the Ecuador project are a key motivation for UPME to adopt the proposed project. UNIDO has a regional office in Colombia with 7 staff: 3 professional staff with extensive project management experience, and one of whom is an environmental engineer by background; 4 general service staff, three of whom have extensive experience in administering projects.

PART III: APPROVAL/ENDORSEMENT BY GEF OPERATIONAL FOCAL POINT(S) AND GEF AGENCY(IES)

A. RECORD OF ENDORSEMENT OF GEF OPERATIONAL FOCAL POINT (S) ON BEHALF OF THE GOVERNMENT(S): (Please attach the [Operational Focal Point endorsement letter\(s\)](#) with this template. For SGP, use this [OFP endorsement letter](#)).

| NAME | POSITION | MINISTRY | DATE (MM/dd/yyyy) |
|-----------------------|--|---|-------------------|
| Mrs. Alejandra Torres | Chief, Office of International Affairs | Ministry of Environment and Sustainable Development | 25 APRIL 2014 |

B. GEF AGENCY(IES) CERTIFICATION

| This request has been prepared in accordance with GEF/LDCF/SCCF/NPIF policies and procedures and meets the GEF/LDCF/SCCF/NPIF criteria for project identification and preparation. | | | | | |
|--|--|-------------------|---|------------------|----------------------------|
| Agency Coordinator, Agency name | Signature | DATE (MM/dd/yyyy) | Project Contact Person | Telephone | Email Address |
| Mr. Philippe Scholtès UNIDO Managing Director Programme Development and Technical Cooperation UNIDO GEF Focal Point |  | 06/06/2014 | Ms. Bettina Schreck Industrial Energy Efficiency Unit  | +43 1 26026-3032 | B.SCHRECK@UNIDO.ORG |

ANNEX A POLICY AND ACTION PLAN DESCRIPTION

Background

Energy intensity in the Colombian economy was of 0,380 barrels of oil equivalent (boe) per USD 1,000. In 2011, energy consumption was 1,100,042 Terajoules, with the industrial sector representing 25.1% of the national energy consumption (UPME 2012).

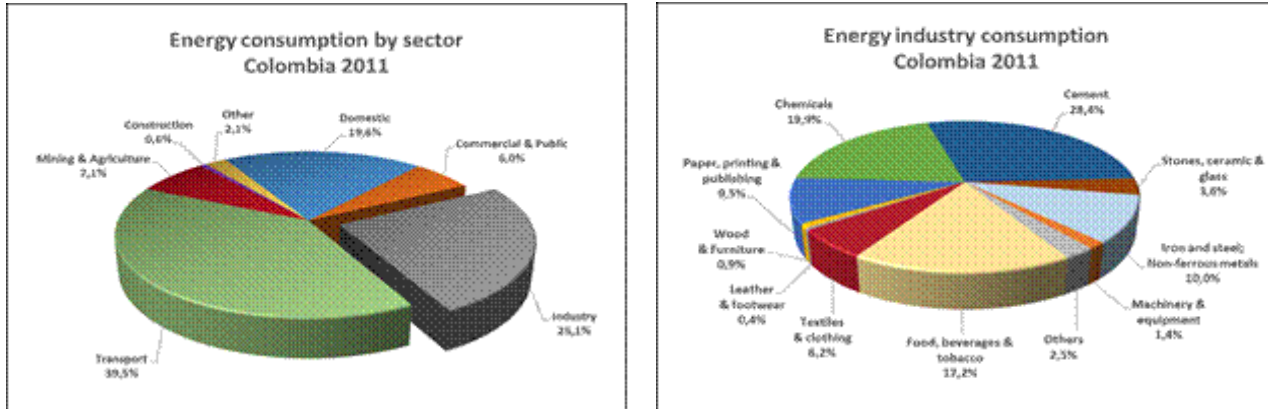


Figure 1. Energy consumption by economic sector

Figure 2. Energy consumption by industrial subsector

The subsectors with the major consumption are Food, Beverage and Tobacco; Cement and Chemicals.

In the industrial sector, that represents about 25% of national energy consumption, significant energy saving opportunities have been identified. In an assessment of technical saving potentials, the main opportunities are as follows: 25% savings for heat transfer, 27% for steam generation and 28% for motor systems.

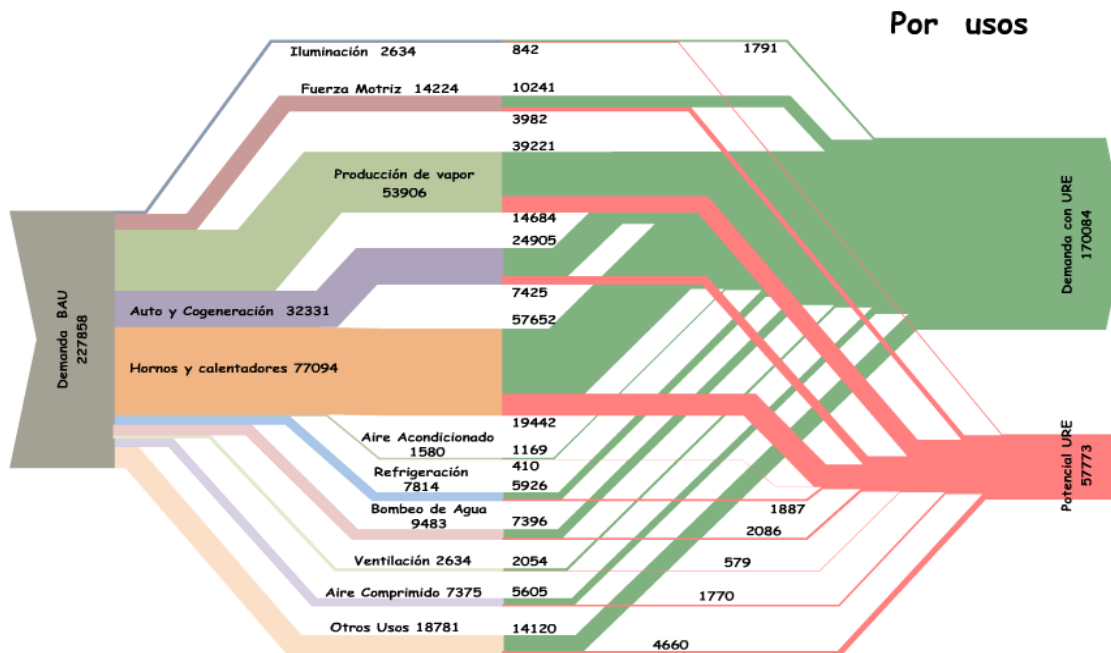


Figure 3. Sankey diagram of energy use in the industrial sector

Standards and technical regulation

Energy efficiency is well-defined in national policy: the law 697 of 2001 recognizes the efficient use of energy as a matter of social, public and national interest. This law has also established the Programme for the Rational and Efficient Use of Energy (PROURE) which promotes the implementation of energy efficiency measures throughout the energy supply chain. This law has been regulated by decrees 3683 of 2003 (amended by decree 2688 of 2008) and 2501 of 2007 which set special provisions for the adoption of energy efficiency measures. These provisions include the creation of an Intersectoral Commission for the Rational and Efficient Use of Energy⁴ (CIURE) as an advisor to the Ministry of Mines and Energy body for decision making in the field.

Setting of national targets and action plans

A key milestone in the development of EE regulation was the issuance of Resolution 180919 of 2010 by which the Ministry of Mines and Energy adopted the 2010-2015 action plan to implement the PROURE. The action plan defines specific subprogrammes, priority activities and targets, as follows:

Strategic subprogrammes of the Action Plan to implement the PROURE (2007-2015)

1. Institutional development
2. Education, technological development and innovation
3. Financial strategies and market promotion
4. Consumer protection and right to information
5. Management and monitoring of targets and indicators
6. Enhanced adoption of NCES

Priority activities

1. Motors optimization
2. Boilers optimization
3. Efficient lighting
4. Comprehensive energy management in industries with emphasis on Cleaner Production
5. Cogeneration and self-generation
6. Rational use of energy in SMEs
7. Combustion processes optimization
8. Cooling processes Optimization

Targets and work plan for EE and NCEs in Colombia

The action plan established 2 implementation phases, first with a 2010-2015 timeframe and a second for 2016-2020. For the first phase the targets are as follows

For Energy Efficiency the joint targets set by the MME and ME are

| Sector | Energy saving target to 2015 (%) | |
|------------|----------------------------------|------|
| Industrial | Electricity* | 3.43 |
| | Fuels | 0.25 |

*Technical potential for electricity savings in the industrial sector is of 5.3%

⁴ The Commission is responsible for the efficient use of energy and the adoption of other “non-conventional” energy sources. National law on rational use of energy (n 697 from 2001) established that non-conventional energy sources (NCES) for Colombia are: solar, wind, biomass, small hydro power (< 10 MW), geothermal, marine and nuclear.

For Non-conventional energy sources

| Share of NCES in the energy mix by 2015 | |
|---|----------------------------|
| Sources connected to the national grid | From decentralized sources |
| 3.5% | 20% |

Technical regulation

The Ministry of Mines and Energy has issued the following mandatory regulations:

- Technical Regulation for Electrical Installations (RETIE): sets the minimum parameters guarantee safety in electricity generation, transmission, transformation, distribution and use
- Technical Regulation for Lighting and Street Lighting (RETILAP) establishes the requirements to be met by lighting systems, designed to ensure the standards and quality of light supplied.

The following regulations are under consideration:

- Technical Regulation of Boiler which aims to establish measures to ensure health and safety in the installation and operation of this equipment
- Technical Regulation of Labelling focused on the Rational Use of Energy: which seeks to implement labels that inform the consumers around the energy consumption of electrical or fuel driven equipment

Voluntary regulations

To support industries in their effort in achieving the national targets, the promotion of energy management systems was adopted as a key national programme. Energy Management Systems (EnMS) are recognized as the proven best practice methodology to ensure proactive and effective energy management. EnMS provides a structured and systematic approach on how to integrate energy efficiency in an enterprise management culture and daily practices. EnMS provide a framework for understanding energy use and consumption.

At the voluntary level Colombia has taken the normalization steps to adopt Energy Management Systems (EnMS) standards. In January of 2012, the ISO 50001 standard was adopted as national technical (NTC-ISO 50001), the national normalization institution is developing a Technical Guide (281/09) to provide enterprises with orientation on the establishment, implementation and improvement of EnMS and their coordination with other Management Systems

Capacity building and outreach on Energy Management Systems - "Comprehensive Energy Management System" (CEMS)

A national programme to develop technical capacities was adopted in the period 2010-2013. This programme, denominated "Comprehensive Energy Management System" (CEMS)⁵, was jointly executed by the Administrative Department of Science, Technology and Innovation (Colciencias), the Mining and Energy Planning Unit (UPME); and financed by the energy utilities.

The programme was centered in establishing an awareness raising, training and dissemination of EnMS which has achieved substantial results during its four years of execution: It was conducted with the support of 15 national universities:

The first action in the programme was a gap analysis for the adoption of EnMS at national level and the identification of the capacity building needs. This analysis was the basis for designing a 'Trainers Programme', to

⁵ Detailed information on the programme, denominated *Sistema de Gestion Integral de la Energia (SGIE)*, is available on the project website <http://www.si3ea.gov.co/> (in Spanish only)

be conducted by university professors. Participants in this course later became part of the faculty. Two training schemes were implemented; an academic diploma course on 'Advance Energy Management' which focused on implementing EnMS and a skills based 'Basic Energy Management' course which provided general understanding to support the adoption of EnMS. Both training schemes were implemented in the five regions: Antioquia, Atlántico, Bogota, Santander and Valle.

The trainees of both programmes were meant to become the initial disseminators of energy management practices, and the programmes were attended by universities, enterprises, cofounders of the program and professionals working in energy areas. The key results of this programme have been:

Capacity building

- Introductory training for users of EnMS – 166 people were trained in 5 training sessions
- Advanced Training on EnMS, a graduate diploma course – 244 people were trained in courses led by 6 different universities. In addition, 68 people were trained out of the context of the CEMS.
- Internal auditor training– 155 people were trained in 5 training sessions led by universities in partnership with the national normalization Institution (ICONTEC)

Awareness raising of enterprises

- Dissemination to 470 enterprises representatives
- Development of energy management plans /energy characterization in 50 enterprises
- Adoption of energy management systems in 12 enterprises

In spite of achieving these results the programme executers have recognized that the CEMS programme was short in achieving its goals. The key barriers they have identified which prevented further adoption include

- Mismatch between the trained implementers and the enterprises, resulting in a high number of trained practitioners but very limited implementation
- Limited practical capacity of trained implementers, as training is academic focused rather than practical
- Limited geographical outreach, focused only on 5 regions

In the meantime, UPME and Colciencias have continued developing activities to promote EnMS in the industries. A new programme called “Consolidation of the Knowledge Network in Energy Efficiency” (RECIEE) was established in 2013 to meet the following goals:

- Determine the energy performance and technological capabilities of 50 enterprises,
- Encourage these enterprises to seek certification in ISO 50001, with a target of reaching certification in 25 of them.
- Promote research activities in the field of energy efficiency including:
 - Comprehensive energy assessments,
 - Industrial motors analysis for Energy Efficiency decision making
 - New efficient cooling technologies.

The RECIE program is being executed by 7 universities and is aimed to be finished in 2016.

Adoption of system optimization measures

In the action plans, the national government identified key technologies that may achieve energy savings which include:

- Promote the replacement of conventional motors for high efficiency motors
- Promote residual heat recovery in combustion processes

These measures have been supported by legislation (resolutions 186, 778, 779 and 563 of 2012) to access fiscal benefits including the dedications of value added tax and net income deduction. In the case of electric motors the

goal is to promote the replacement of low efficiency (classes IE0⁶ low efficiency and IE1 standard efficiency) by high efficiency motors (classes IE2 high efficiency and IE3 premium efficiency). The impact of motors replacement is substantial, as it represents 70% of the total electrical energy consumed in the industrial sector.

Both measures promote the adoption of more efficient equipment or processes. The presence of energy-efficient components in industrial systems, while important, provides no assurance that energy savings will be attained if the system is not properly designed and operated. Evidence from implemented national and international programmes shows that, while efficient components may bring about gains in the range of 2 to 5 percent, systems optimization measures can attain average efficiency gains of 20 to 30 percent with a payback period of less than 2 years. The implementation of system optimization measures requires specific technical knowledge and consistent monitoring and remedy action by the industry.

Science, Technology and Innovation Policy

The National Science, Technology and Innovation System” (established under law 1286 of 2009), which defines within its scope all actions that support the promotion of increased productivity and national competitiveness”. In the systems, innovations are considered a mechanism that begins with knowledge of methodologies, to the adoption of processes, technologies and new products that have market impact contributing to enterprises.

This law promotes such measures by providing fiscal incentives (see following section); as well as mechanisms for the financing of innovative projects in industries which are contributing with knowledge on productivity and competitiveness in the productive sector; which are either undertaken directly by enterprises or with the support of universities. Examples of programmes which have been established under this mechanism are the CEMS project describe earlier and the “National Program for Industrial Technological Development and Quality” that contributes to the transfer of knowledge for modernization and transformation of the manufacturing industry through the development of innovative projects and technological development in rational and efficient use of energy.

Fiscal incentives

Another main promotion policy has been the provision of fiscal incentives. The national fiscal policy (law number 223 from 1995 and administrative amendments) established a mechanism to provide fiscal incentives, including VAT elimination and reduction of income tax, for equipment and element for environmental monitoring and control, focusing on noxious pollutants to the environment. The regulatory decrees of this law state that such incentives could also be given to projects or programmes which reduce energy consumption or promote energy efficiency; provided that these incentives would be used to support measures required to meet environmental targets set jointly by the Ministries of Environment and Sustainable Development (MESD) and of Mines and Energy (MME).

In 2012 the two Ministries have progressed in setting joint targets to be met by 2015 (joint resolution n 168 of 2012) for energy efficiency (EE) in industry and transport sector, as well as for renewable energy, the so-called non-conventional energy sources (NCES)⁷ in Colombia. During 2013 only 29 projects have been submitted. Projects are categorized under the strategic action lines as shown in the following table

Table 1. Submissions for the fiscal incentives in 2013

| Action line | Number of requests |
|---|--------------------|
| Use of waste heat from combustion processes | 11 |
| Replacement of motors for high efficiency ones | 2 |
| Characterization or measurement of the potential for NCES | 3 |

⁶ Motor classes IE0, IE1, IE2 and IE3 are defined by standard IEC 60034-30 on efficiency classes for low voltage AC motors
⁷ National law on rational use of energy (n 697 from 2001) established that non-conventional energy sources (NCES) for Colombia are: solar, wind, biomass, small hydro power (< 10 MW), geothermal, marine and nuclear

| Action line | Number of requests |
|--|--------------------|
| Development of NCES demonstration projects | 5 |
| Scale-up of clean transport systems | 7 |
| Promote the use of electric or hybrid vehicles in mass transport | 1 |
| Total | 29 |

These request represents economic benefits for enterprise's in the order of U\$S 40 million (Colombian pesos 80,000 million). However the use of the incentives remains limited.

Market promotion – Promotion of Market Opportunities for Clean Energy (OPEN)

A technical cooperation programme was executed by the Chamber of Commerce of Bogota, and support from the Multilateral Investment Fund (MIF) of the Inter-American Development Bank, between 2009 and 2012. The goal of this project was developing market opportunities for EE amongst consultants, engineering firms, technology providers, financial institutions and managers of middle size enterprises.

This programme had positive results:

- 90 entrepreneurs from engineering consultancies were trained in the concept of Energy Service Companies (ESCO) models,
- 9 enterprises were selected 8 to provide technical services of enterprises, establishing contracting mechanisms as ESCOs
- 180 SMEs from 13 industrial sectors implemented projects in Best Operational Practices for Energy Efficiency, resulting in an average of 8% improvement in energy efficiency
- 34 feasibility studies to adopt upgrading projects were developed.
- Among these 34, 24 projects were selected for financing, these project were presented to banks for being financed through performance contracts executed by newly created Energy Service Companies (ESCO) participating in the program, resulting in improvements of up to 20%
- 2 Business rounds tables were held between ESCOs, SMEs and Banks to established financing mechanism

The main objectives of this programme were met but some carriers remain. It was expected for the ESCOs to establish contracts with the industries and the banks to finance the projects. However, the amounts of the investments were not attractive to the banks. In addition, the ESCOs had experience working with energy efficiency projects but not with energy performance contracts and they lacked the legal and financial support to structure the projects. The market wasn't mature and the actors didn't have enough trust.

Promotion of EE in other economic sectors

The national government has been active in promoting holistic programmes to address EE adoption in priority sectors. Such initiatives include the following programmes

CO-EFFICIENCY: Improving Energy Efficiency in Buildings in Colombia through Synergies between Environmental Conventions (GEF ID 3479, implemented by UNDP, under implementation) which focused on promoting the adoption of energy efficiency in public buildings; creating the necessary national capacities on energy efficiency (EE); encouraging the replacement of energy inefficient appliances and other building equipment; and facilitating the establishment of a National Energy Efficiency Agency.

Actions undertaken included the:

- Development of a technical regulation for energy efficiency for social housing that takes into account the life cycle energy consumption of the domestic buildings and comfort aspects for dwellers.

⁸ A call for applicants was made, with 90 organizations responded to the initial announcement and 35 short listed. Only 9 of the companies qualified and were selected to execute the measures in SMEs

- Determined the energy consumption in the manufacturing process of building materials (conventional and alternative) and the physical properties of such materials that affect the energy performance of buildings.
- Development of a technical standard for sustainable construction for non-residential buildings which is an important step to motivate the construction sector to implement energy efficiency criteria in the design and construction of buildings in the country.
- 32 energy audits in public buildings identifying no, low, moderate, and high investment measures emphasizing the importance of implementing all the measures due to the benefits derived for the entities and the promotion potential this topic can have in their regions increasing the benefits for the community.
- A key result of this programme is to create a national energy efficiency agency to promote EE. Through a detailed analysis, eight alternatives were considered to select the best option and design the needs, objectives, functions, personnel and business model of the agency to make it sustainable through time.

Energy Efficiency Standards and Labels in Colombia (GEF ID 3930, implemented by UNDP, under implementation) focused on the adoption of standards and labels for household appliances.

This programme builds on the achievements of nationally energy efficiency labelling programme, known as CONOCE (*Programa de Normalización, Acreditación, Certificación y Etiquetado de Equipos de Uso Final de Energía*). The programme's main activities include capacity building; assisting government, manufacturing, distributing, retail, consumer and environmental stakeholders to implement the most cost-effective energy efficiency measures available and overcome the institutional, technical and awareness-related barriers that impede the implementation of a comprehensive market transformation strategy.

ANNEX B ESTIMATED GHG EMISSION SAVED

Macroeconomic analysis

The energy saving targets set by the government in the action plan of the PROURE in the period 2010-2015, is of

- 3.43 % for electricity yearly
- 0.25% for fuels equivalent to yearly

In addition calculated energy growth for the decade 2010-2020 is

- 3.9 % for electricity yearly
- 3.6% for fuels equivalent to yearly

Energy use in the industrial sector in 2011 was of 227,858 TJ (see Sankey diagram in Annex A), of which 28.3% was electricity use and 71.7% diesel.

The estimated energy demand for industry the Business as Usual (BaU) scenario

| BaU-scenario | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|-----------------|---------|---------|---------|---------|---------|---------|---------|
| electricity use | 64,525 | 67,041 | 69,656 | 72,373 | 75,195 | 78,128 | 81,175 |
| fuel use | 163,331 | 169,211 | 175,303 | 181,613 | 188,151 | 194,925 | 201,942 |

The estimated energy demand for industry in meeting the PROURE targets (assuming that the target remains equally stringent after 2015)

| PROURE targets | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|-----------------|---------|---------|---------|---------|---------|---------|---------|
| electricity use | 64,525 | 62,312 | 60,174 | 58,111 | 56,117 | 54,192 | 52,334 |
| fuel use | 163,331 | 162,923 | 162,515 | 162,109 | 161,704 | 161,300 | 160,896 |

Energy savings that result from meeting the targets

| savings | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|-----------------|------|-------|--------|---------------|---------------|---------------|---------------|
| electricity use | - | 4,730 | 9,482 | 14,262 | 19,078 | 23,935 | 28,841 |
| fuel use | - | 6,288 | 12,787 | 19,504 | 26,448 | 33,625 | 41,046 |

The savings that would occur during the project execution (mid 2014 to mid-2017) equal to

- Electricity 64,565 TJ
- Fuel 90,348 TJ

The direct implementation of the project will results in 200 enterprises adopting EnMS and/or SO measures. According to the annual manufacturing survey there were 9460 enterprises in Colombia in 2012 (DANE, 2012). Therefore, the direct impact of the projects could be considered to support 2% of the national savings.

These savings translate into the following greenhouse gas emission reductions:

| | 2% Saving | | Emission factor | | Emission reductions | |
|--------------|-------------|-----|-----------------|------------|---------------------|-------------|
| Electricity | 379,168,812 | KWh | 0.317 | Kg CO2/KWh | 120,197 | tCO2 |
| Fuel | 1,910 | TJ | 74067 | Kg CO2/TJ | 141,476 | tCO2 |
| Total | | | | | 261,673 | tCO2 |

Microeconomic analysis

The OPEN project has conducted a detailed characterization of energy use in 180 SMEs and determined the savings to be derived from the implementation of typical EE practices including 1) best operational practices and 2) for technology retrofits, resulting in an average 28 % saving.

When estimating the energy saving associated to these characterization it is observed that the results in SMES are more modest than in the macroeconomic analysis:

| | Yearly energy use (KWh) in 180 SMEs | Yearly savings expected (KWh) - 28 % |
|-------------|-------------------------------------|--------------------------------------|
| Coal | 93,890,803 | 26,289,425 |
| Natural gas | 5,260,005 | 1,472,801 |
| Electricity | 7,157,523 | 2,004,106 |

These savings translate into the following greenhouse gas emission reductions:

| | 28% Saving | | Emission factor | | Yearly emission reductions | |
|--------------|------------|-----|-----------------|------------|----------------------------|-------------|
| Coal | 94.64 | TJ | 97257 | Kg CO2/TJ | 9,205 | tCO2 |
| Natural gas | 5.30 | TJ | 55340 | Kg CO2/TJ | 293 | tCO2 |
| Electricity | 2,004,106 | KWh | 0.317 | Kg CO2/KWh | 635 | tCO2 |
| Total | | | | | 10,133 | tCO2 |

A detailed analysis of the direct and indirect (bottom up and top down) GEBs will be conducted during the project design phase.