Evaluation of the Projects:

“Advancing Metrology for Energy Efficient Measurements and Compliance in Central America and Dominican Republic” (M4EE)

And

“Advancing Metrology for Sustainable Energy Technologies and the Environment in the Western Hemisphere - Second Phase” (M4SET)

Final Report

Luis Bernal MPP
November 5th, 2020

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National Institute of Standards and Technology
U.S. Department of Commerce

metrología para las
TECNOLOGÍAS ENERGÉTICAS
SOSTENIBLES Y EL MEDIO AMBIENTE

METROLOGÍA PARA TECNOLOGÍAS
ENERGÉTICAMENTE EFICIENTES

Science, technology, medicine, trade and industry -in fact all human life - relies on measurement.

Importantly, these systems work because we have confidence in the measurements made. Our measurements are trustworthy at the level we need them to be to achieve our objectives.

This confidence does not happen by accident but is a result of a well-established infra-technology -our measurement infrastructure: agreed globally and implemented locally- an invisible glue that binds together science and technology and enables all progress.

The measurement infrastructure is like the road network, allowing the smooth passage of traffic, or measurements, adding value for the economy and quality of life, continuously delivering real world impact and enabling new technologies to solve current challenges. It covers everything in the measurement chain from the definition of measurement units agreed globally by governments, through agreed standard methods for measurement, to the reliability of end user measurements in the field, in hospitals or in factories – for example by enabling worldwide stable and consistent dimensional measurement to ensure automotive parts made in several different locations always meet required tolerances and as a result may be assembled quickly, with confidence and without waste. (Source: U.K. National Physical Laboratory, 2020)

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Acronyms

ANDIMET	Andean Metrology Institutions
CAMET	Central America Metrology Institutions
CARIMET	Caribbean Metrology Institutions
CBA	Cost Benefit Analysis
DR	Document Review
EE	Energy Efficiency
EQ	Evaluation Question
ET	Evaluation Team
GHG	Green House Gases
KII	Key Informant Interview
LAC	Latin-America and the Caribbean
M4EE	Metrology for Energy Efficiency CA+DR
M4SET	Metrology for Sustainable Energy Technologies and the Environment (Hemispheric)
NIST	U.S. National Institute of Standards and Technology
NMI	National Metrology Institutions
OAS	Organization of American States
OAS - DPE	Organization of American States - Department of Planning and Evaluation
OAS - DSD	Organization of American States - Department of Sustainable Development
OAS - GS	Organization of American States - General Secretariat
OAS - SEDI	Organization of American States - Secretariat for Integral Development
OS	Online Survey
RECS	Renewable Energy and Climate Science
RTCA	Central American Technical Regulations
SICA	Central America Integration System
SID 1605	Metrology for Energy Efficiency CA+DR (This project)
SID 1606	Metrology for Sustainable Energy Technologies and the Environment (Hemispheric)

SIM	Inter-American Metrology System
SURAMET	Southern Cone Metrology Institutions
ToC	Theory of Change
ToR	Terms of Reference

Executive Summary

Figure 1. Evaluation Summary

OEA

"Advancing Metrology for Energy Efficient Measurements and Compliance in Central America and Dominican Republic" (M4EE)
And
"Advancing Metrology for Sustainable Energy Technologies and the Environment in the Western Hemisphere - Second Phase" (M4SET)
Final Evaluation Sept-Nov 2020

Purpose: determine and assess the efficiency, effectiveness, and sustainability of both metrology projects

34 countries in LAC

USD $ 2.1 m Invested

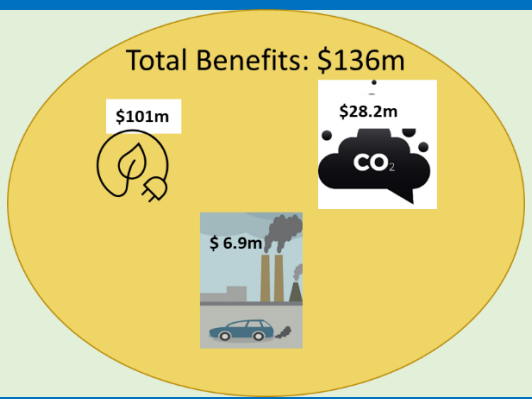
22
- Awareness
- Training
- Technical Assistance
- Technical Exchanges

- 29 Stakeholders interviewed
- 46 Survey respondents

Relevance	Effectiveness	Efficiency	Sustainability
96%	81%	89%	65%
High of very high	High of very high	High of very high	High of very high

Cost-Benefit Analysis

M4SET and M4EE contribute significantly to the economy and well-being of the people of Latin America and the Caribbean. In total their contribution is estimated to be US$ 136.6m at a cost of just over US$ 2.3m



The Net Present Value of the programs' benefits is $134.1m and the Return on Investment is estimated at 57.7

Introduction

This document presents the final evaluation report of the projects "Advancing Metrology for Energy Efficient Measurements and Compliance in Central America and Dominican Republic" and "Advancing Metrology for Sustainable Energy Technologies and the Environment in the Western Hemisphere - Second Phase", requested by the U.S. Permanent Mission to the Organization of American States (OAS), and being coordinated by its Department of Planning and Evaluation (OAS-DPE).

This is an external, independent evaluation. Luis Bernal, MPP was in charge of it as an individual contractor; he is solely responsible before for the evaluation, its deliverables and overall quality; however, he resorted to the extensive expertise of Dr. Ulrike Hotopp to lead the Cost Benefit Analysis (CBA) of the projects requested by the Terms of Reference (ToR), and therefore the two constitute the Evaluation Team (ET) for such purpose. The evaluation was conducted remotely from the evaluator's office. It started with an online kickoff meeting on August 19th, 2020 and concluded with the submission of a final evaluation report on November 6th, 2020.

Programs summary

The Advancing Metrology for Sustainable Energy Technologies and the Environment in the Western Hemisphere - Second Phase" (M4SET) focused on the environmental aspect of metrology, as well as the support to measurement aspects associated with sustainable energy, natural resources monitoring and clean air. The problem that the project sought to address was the limited technical and technological capabilities of several countries in LAC on measurements associated to alternative energy, energy efficiency and air quality. Effective policymaking and enforcement require coordination between regulators and technical agencies. To enforce this important connection between the technical and the political, the project requested the designation of one technical and one political focal point in each country. Directors of the national metrology institutes (technical focal points) and political focal points, via the project planning committee, were invited to plan the instances of technical training to be delivered, and were responsible for defining their content based on their countries' priorities and needs. The project implementing team engaged with key stakeholders in each country to gather the trainings needs as well as to follow up after the technical trainings and project activities are implemented.

The Advancing Metrology for Energy Efficient Measurements and Compliance in Central America and Dominican Republic" (M4EE) aimed to strengthen measurement capabilities and knowledge of government officials and technical stakeholders in the field of energy efficiency in Central America and Dominican Republic. The project addressed this issue and the need of countries to invest on technology infrastructure and so due to lack of standards laboratories in the region, OAS and NIST built a closer relation with countries that have a good infrastructure to participate in the project. M4EE offered support through awareness-raising actions and the facilitation of knowledge sharing, best practices, technical training and exchanges to increase metrology and conformity assessment's skills of government officials and technical stakeholders engaged in the implementation and enforcement of national policies, laws and regulations on energy efficiency in Central America and Dominican Republic.

Evaluation purpose and audience

The purpose of the external evaluation, according to its ToR, is to determine and assess the efficiency, effectiveness, and sustainability of both metrology projects, by analyzing the delivery of the main outputs, and the immediate and intermediate outcomes for the projects, including a cost benefit analysis. Likewise, the evaluation must document lessons to be learned and make recommendations regarding projects' formulation, design, implementation, management, and sustainability. Finally, the evaluation must determine whether the projects addressed the "gender

perspective" and to what results. The evaluation, in addition to systematizing and documenting the results of the projects, have the goal of capitalizing on these experiences for the improvement of future project and program formulations and designs, and institutionalizing best practices in monitoring and evaluation within the OAS.

The main audience of the evaluation is made up by the OAS General Secretariat, including its Department of Planning and Evaluation (OAS-DPE), the main implementers of the projects: OAS Department of Sustainable Development (OAS-DSD) along with the U.S. National Institute of Standards and Technology (NIST) and the projects main donor, the U.S. Permanent Mission to the Organization of American States.

Evaluation design and methodology

The evaluation was conducted remotely from the evaluator's office. It started with an online kickoff meeting on August 19th, 2020 and concluded with the submission of a final evaluation report on November 8th, 2020. Luis Bernal MPP is responsible for the evaluation but he resorted to Dr. Ulrike Hotopp for the cost-benefit analysis (CBA)

The evaluation is a mix-methods, non-experimental, theory-based evaluation that includes a revisiting of the projects' Theory of Change (ToC). It includes an estimation of economic and social benefits of the projects, through CBA. Likewise, it includes a review of the projects' experience using the Kirkpatrick model for training evaluation and also ana analysis of the gender perspective in the programs.

Data collection methods included document and literature review, remote interviews to 29 individuals, and an online survey responded by 46 people.

OAS postulated the following evaluation questions: i) Were the output and outcome indicators achieved? If not, explain why, ii) Were the results achieved attributable to the actions of the operation? iii) If empirical attribution cannot be stablished, is there a robust theoretical attribution? iv) Did the project's team apply results-based management principles from its inception to its conclusion? v) Were lessons learnt identified during the implementation of the projects? vi) Was the monitoring mechanism used as an efficient and effective tool to follow-up on the progress of projects' actions? iv) Were there any unforeseeable/not planned results or outcomes?

Answers to the EQs are sought within the framework of the following evaluation criteria: i) relevance, ii) attribution, iii) effectiveness, iv) efficiency, v) sustainability, vi) "gender approach".

Findings, conclusions, and recommendations

Findings

- The extent to which the projects activities and design responded to specific needs, policies or priorities was evidenced at several levels. Stakeholders considered M4SET and M4EE highly relevant.

- M4SET and M4EE clearly achieved their results (outputs, outcomes, purpose, and goals). Not merely they met their performance indicators, but they achieved many tangible personal, institutional, and technological transformations.

- The ToC of the projects is mostly valid and confirms causality between project's actions and their results, in both the short and the long term.

- Documents, data, and testimonials, as well as theoretical considerations assert the projects' attribution, in other words that there is a causal link between projects' initiatives and demonstrable effects whether they are in terms of individuals' technical skills, institutions' new capabilities or relationships, or changes in the policy environment.

- A key element in securing attribution, as well as project's effectiveness, was the application of results-based management principles, practices, and procedures from projects' design to closing.

- Both projects achieved a considerable economic and social return of investment as determined by its CBA

- Applying RBM, along with a systematic monitoring of projects' stakeholders, activities and results allowed the project implementation team, together with other stakeholders, to be aware of changing circumstances, learn the corresponding lessons and be able to adapt activities accordingly.

- M4SET and M4EE made an efficient utilization of time, staff, and partnerships. Efficiency in assignation of budget is an institutional matter that falls beyond the scope of this evaluation.

- Although the immediate financial sustainability of projects' activities is null due to the lack of funding, the economic, technological, political, and environmental sustainability of the activities carried out by the projects is significant.

- Although recognized as an essential element of any project for development, the gender perspective in the projects and in metrology in general, remains a challenge both conceptually and programmatically.

- MA4SET and M4EE did find unforeseeable/not planned results or outcomes, such as the active networking, collaboration, and mutual technical support among individuals who participated in projects' activities, or the challenges, solutions and potential of remote technical cooperation imposed by the COVID-19 pandemic.

Conclusions

- MASET and M4EE demonstrated the great potential of the south-south cooperation for development, whenever it aims to solve problems of regional interest, through projects well-conceived and managed.

- Although the INMs may be isolated from decision-making and other technological institutions in their countries, they are receptive to initiatives that could enhance their contribution to national and international objectives towards the adoption of sustainable energy and air quality technologies aimed to foster a low carbon economic growth in the Americas.

- The formation and maintenance of adequate technical and policy-making contacts/partners, people, and institutions, in the countries is essential for effective project implementation.

- As successfully learned from M4EE and its positive relation with SICA, whenever a project aims to public policy-making, besides being well designed and implemented a technology-related project needs to be furnished with lobbying capabilities that allows it to "speak-policy' in an effective way.

- The success of OAS in implementing M4SET and M4EE is, however, dependent of money, knowledge, as well as technical and management staff, the organization normally lacks. This made the OAS-NIST partnership a powerful and synergic alliance highly valued by people, institutions, and countries.

- Despite scarce resources, the projects demonstrated the power of motivated individuals practicing networking and thereby contributing to achieving common goals.

- The projects raised the visibility of metrology in LAC and strengthened the Interamerican Metrology System - SIM

Recommendations to OAS

- Make sure to retain within the organization the knowledge, experience, and skills acquired by the implementation team through the projects' lifecycle. This human capital will be valuable to design and execute similar initiatives in the future.

- Document the experience so that best practices, lessons learned, results, as well as difficulties and setbacks experienced by the projects from design to completion, are systematically recorded.

- Share success with other OAS areas. With a properly documented experience will be possible for other areas of the OAS, particularly those involved in project implementation, to learn an accumulate institutional knowledge.

- Within the framework of ECPA, keep the momentum achieved by the projects by keeping in touch with stakeholders and their networks. By playing "I know who know what you don't know", sharing low cost information, and being active with those OAS-DSD might be able to contribute to the sustainability of the projects.

- Divulge experiences, lessons, and success throughout the region stakeholders both in the metrology, energy quality, energy efficiency and air quality communities, and the policy-making actors not only of those countries that participates in M4SET and M4EE but throughout the whole LAC.

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"Advancing Metrology for Energy Efficient Measurements and Compliance in Central America and Dominican Republic" (M4EE)
And
"Advancing Metrology for Sustainable Energy Technologies and the Environment in the Western Hemisphere - Second Phase" (M4SET)
EVALUATION FINAL REPORT

1. Introduction

This document presents the final evaluation report of the projects "Advancing Metrology for Energy Efficient Measurements and Compliance in Central America and Dominican Republic" and "Advancing Metrology for Sustainable Energy Technologies and the Environment in the Western Hemisphere - Second Phase", requested by the U.S. Permanent Mission to the Organization of American States (OAS), and being coordinated by its Department of Planning and Evaluation (OAS-DPE). OAS-DPE launched the Terms of Reference included in Annex A

This is an external, independent evaluation. Luis Bernal, MPP was in charge of it as an individual contractor; he is solely responsible before for the evaluation, its deliverables and overall quality; however, he resorted to the extensive expertise of Dr. Ulrike Hotopp to lead the Cost Benefit Analysis (CBA) of the projects requested by the Terms of Reference (ToR), and therefore the two constitute the Evaluation Team (ET) for such purpose.

The evaluation was conducted remotely from the evaluator's office. It started with an online kickoff meeting on August 19th, 2020 and concluded with the submission of a final evaluation report on November 5th, 2020.

1.1. Evaluation purpose and audience

The purpose of the external evaluation, according to its ToR, is to determine and assess the efficiency, effectiveness, and sustainability of both metrology projects, by analyzing the delivery of the main outputs, and the immediate and intermediate outcomes for the projects, including a cost benefit analysis. Likewise, the evaluation must document lessons to be learned and make recommendations regarding projects' formulation, design, implementation, management, and sustainability. Finally, the evaluation must determine whether the projects addressed the "gender perspective" and to what results.

The evaluation, in addition to systematizing and documenting the results of the projects, have the goal of capitalizing on these experiences for the improvement of future project and program formulations and designs, and institutionalizing best practices in monitoring and evaluation within the OAS.

The main audience of the evaluation is made up by the OAS General Secretariat, including its Department of Planning and Evaluation (OAS-DPE), the main implementers of the projects: OAS Department of Sustainable Development (OAS-DSD) along with the U.S. National Institute of Standards and Technology (NIST) and the projects main donor, the U.S. Permanent Mission to the Organization of American States.

1.2. Projects' description

The Advancing Metrology for Sustainable Energy Technologies and the Environment in the Western Hemisphere - Second Phase" (M4SET) focused on the environmental aspect of

metrology, as well as the support to measurement aspects associated with sustainable energy, natural resources monitoring and clean air. The problem that the project sought to address was the limited technical and technological capabilities of several countries in LAC on measurements associated to alternative energy, energy efficiency and air quality. Effective policymaking and enforcement require coordination between regulators and technical agencies. To enforce this important connection between the technical and the political, the project requested the designation of one technical and one political focal point in each country. Directors of the national metrology institutes (technical focal points) and political focal points, via the project planning committee, were invited to plan the instances of technical training to be delivered, and were responsible for defining their content based on their countries' priorities and needs. The project implementing team engaged with key stakeholders in each country to gather the trainings needs as well as to follow up after the technical trainings and project activities are implemented.

The Advancing Metrology for Energy Efficient Measurements and Compliance in Central America and Dominican Republic" (M4EE) aimed to strengthen measurement capabilities and knowledge of government officials and technical stakeholders in the field of energy efficiency in Central America and Dominican Republic. The project addressed this issue and the need of countries to invest on technology infrastructure and so due to lack of standards laboratories in the region, OAS and NIST built a closer relation with countries that have a good infrastructure to participate in the project. M4EE offered support through awareness-raising actions and the facilitation of knowledge sharing, best practices, technical training and exchanges to increase metrology and conformity assessment's skills of government officials and technical stakeholders engaged in the implementation and enforcement of national policies, laws and regulations on energy efficiency in Central America and Dominican Republic.

Below there is a summary description of both projects based in their respective Project Documents (Prodocs)

Name: Advancing Metrology for Sustainable Energy Technologies and the Environment in the Western Hemisphere – Second Phase SID1606 (a.k.a. M4SET)

Prodoc date: 4/24/2017
Estimated Duration: 48 months
Estimated Start Date: 11/9/2016

Beneficiary Countries: Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay, Venezuela.

Beneficiary Individuals: high-ranking government officials and experts engaged in climate change, renewable energy and energy efficiency policy making, regulation and enforcement: i) Ministries of Energy, Environment and Commerce, ii) NMIs, iii) Accreditation and Normalization Bodies, iv) Universities and other institutions related to climate change and sustainable energy.

Problems to be addressed

- Investments needed for a sustainable low carbon future
- Limited technical and technological capabilities of the region on measurements associated to alternative energy, energy efficiency and air quality
- Awareness and training needed
- Lack of interaction between decision-makers and metrology technical officers

Assumptions

- Governments are interested in strengthening their measurement infrastructures to support green technology development and monitoring.
- Agencies are interested and support the implementation of the projects that emerge from the technical exchanges
- Focal Points participate actively in the planning of project activities, follow up on activity outputs and provide information with regard to priorities and needs.
- There are no administration changes in beneficiary countries, or such changes do not delay or obstruct project execution.

GOAL: To support the deployment of sustainable energy technologies and foster low carbon economic growth in the Americas.

Purpose: To strengthen the technical and technological capabilities of the metrology community, government officials and other technical stakeholders in the fields of energy efficiency, renewable energy, air quality and greenhouse gases in beneficiary countries

Results at the level of Outputs

Output 1: High-ranking officials mindful of the value of metrology applications for advancing greenhouse gas emissions reduction, air quality monitoring and improving measurement infrastructure for sustainable energy development in the Americas.

Activity 1.1 Identify institutions conducting initiatives on air quality, renewable energy and energy efficiency in the Americas and establish strategic alliances to further energy sector transformation

Activity 1.2: Organize three high level public fora with strategic partners to raise awareness among government officials regarding the value of metrology as a means to support renewable energy, energy efficiency and air quality.

Output 2: Government officials from ministries of energy, environment, energy, commerce, national metrology institutes, accreditation and normalization bodies and academia increased knowledge in measurement sciences applied to air quality, greenhouse gas emissions, and renewable and efficient energy standards.

Activity 2.1: Organize at least five long-term (up to six months) technical exchanges on measurement and technical testing capabilities associated with air quality, GHG measurement, energy efficiency and renewable energy for national metrology institute officials.

Activity 2.2: Organize three one-week technical exchanges on energy efficiency and climate science policy and regulation with private and public sector institutions.

Activity 2.3: Organize at least two government expert trainings on measurement standards for renewable energy and energy efficiency to support air quality assessment and greenhouse gas monitoring.

Activity 2.4: Selection process of the requests for technical cooperation from beneficiary countries.

Output 3: Project planning, monitoring, administration, and evaluation.

Activity 3.1: Development of project profile and/or project document and monitoring plan.

Activity 3.2: Management and supervision of the project

Activity 3.3: Development, collection, and analysis of pre and post knowledge or follow-up questionnaires for participants in the capacity building activities of the project

Activity 3.4: Collection data and information for monitoring reports

Activity 3.5: Compilation, analysis, and validation of final reports.

Activity 3.6: Prepare semiannual progress reports and final report

Activity 3.7: Define terms of reference in collaboration with the Department of Planning and Evaluation for external evaluator

Activity 3.8: Coordination and execution of External evaluation of the results of project

Activity 3.9: Disseminate project results

Responsible and Other Participating Departments (OAS): Department of Sustainable Development (DSD)

Executing Institution: Organization of American States- Department of Sustainable Development

Counterpart Agencies:

1. PMUREE
2. Inter-American Metrology System (SIM) - CAMET Region (Central America)
3. National Ministries Involved
4. ECPA Focal Points

Total Estimated Budget (US $) by Source of Financing

Source	Contribution	ICR	Cont.	Available	%
NIST	125,000.00	0.00 %	0.00 %	125,000.00	11.44 %
Beneficiary Countries In-Kind	125,250.00	0.00 %	0.00 %	125,250.00	11.46 %
GS/OAS	150,142.40	0.00 %	0.00 %	150,142.40	13.74 %
US/OAS	795,678.16	13.00 %	0.00 %	692,240.00	63.36 %
Total:	1,196,070.56			1,092,632.40	

Name: Advancing Metrology for Energy Efficient Measurements and Compliance in Central America and Dominican Republic SID1605 (a.k.a. M4EE)

Prodoc date: 6/7/2017
Estimated Duration: 48 months
Estimated Start Date: 11/9/2016

Beneficiary Countries: Belize, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, Panama

Problems to be addressed

- Countries' technical limitations in measuring aspects for conformity assessment, energy efficiency standards and labeling programs for equipment and appliances, and adequate testing facilities
- Lack of adequate measurement and infrastructure standards make it difficult to apply current laws and regulations.
- Lack of coordination between decision-makers and the metrology communities

Assumptions

- Energy efficiency continues to be a priority topic for Central America and Dominican Republic
- Trained officials stay in their organizations and implement projects/actions derived from technical exchanges
- Administration changes in beneficiary countries significantly do not delay or obstruct project execution.
- Focal Points participate actively in the planning of project activities, follow up on activity outputs and provide information with regard to priorities and needs.

GOAL: To contribute to a sustainable energy policy development in Central America and Dominican Republic

Purpose: To strengthen measurement capabilities and knowledge of government officials and technical stakeholders in the field of energy efficiency in Central America and Dominican Republic.

Results at the level of Outputs

Output 1: High-ranking officials in Central America and Dominican Republic mindful of the value of metrology to address energy efficiency policymaking for household air conditioners, refrigerators, lamps and electric motors.

Activity 1.1: Identify institutions conducting energy efficiency initiatives and programs and establish strategic alliances to further energy efficiency

Activity 1.2: Organize two high-level public fora with strategic partners to raise awareness among government officials regarding the value of metrology as a means to support energy efficiency.

Output 2: Technical experts from ministries of energy, environment, energy, commerce, national metrology institutes, accreditation and normalization bodies and academia in Central America and Dominican Republic increased knowledge in energy efficiency performance and measurement standards and testing protocols for equipment and appliances.

Activity 2.1: Organize one meeting with government experts to discuss the implementation of the Central American Regional Technical Regulation on energy efficiency for appliances and equipment.

Activity 2.2: Organize at least two technical trainings for government experts on technical aspects associated with energy performance standards and testing and enforcement protocols for the implementation of the Central American Technical Regulation on energy efficiency for equipment and appliances.

Activity 2.3: Organized at least four webinars on energy efficiency measurements and compliance

Activity 2.4: Organize at least three technical exchanges on energy efficiency for national metrology institutes or technical agencies involved in the design and implementation of the RTCA.

Activity 2.5: Coordinate the delivery of technical advice according to requests from beneficiary countries.

Activity 2.6: Selection process of the requests for technical cooperation (technical training, exchanges and advise) from beneficiary countries.

Output 3: Project planning, monitoring and evaluation.

Activity 3.1: Development of project profile and/or project document and monitoring plan.

Activity 3.2: Management and supervision of the project

Activity 3.4: Collection data and information for monitoring reports

Activity 3.5: Compilation, analysis, and validation of final reports

Activity 3.6: Prepare semiannual progress reports and final report.

Activity 3.7: Define terms of reference in collaboration with the Department of Planning and Evaluation for external evaluator

Activity 3.8: Coordination and execution of External evaluation of the results of project

Activity 3.9: Disseminate project results

Responsible and Other Participating Departments (OAS): Department of Sustainable Development (DSD)

Executing Institution: Organization of American States- Department of Sustainable Development

Counterpart Agencies:

5. Inter-American Metrology System (SIM) - CAMET Region (Central America)
    1. Belize Bureau of Standards
    2. Laboratorio Costarricense de Metrología (LACOMET)
    3. Centro de Investigaciones de Metrología – El Salvador
    4. Centro Nacional de Metrología – Guatemala
    5. Centro Hondureño de Metrología
    6. Laboratorio Nacional de Metrología (LANAMET)- Nicaragua
    7. Centro Nacional de Metrología Panamá
    8. Instituto Dominicano para la Calidad
6. Central America Integration System (SICA)
7. Designated National Ministries

Total Estimated Budget (US $) by Source of Financing

Source	Contribution	ICR	Cont.	Available	%
Beneficiary Countries In-Kind	67,400.00	0.00 %	0.00 %	67,400.00	6.62 %
NIST	125,000.00	0.00 %	0.00 %	125,000.00	12.28 %
GS/OAS	150,142.40	0.00 %	0.00 %	150,142.40	14.75 %
US/OAS	776,275.86	13.00 %	0.00 %	675,360.00	66.35 %
Total:	1,118,818.26			1,017,902.40	

2. Evaluation design and methodology

The evaluation is non-experimental and largely qualitative in nature, but mixed methods will be used as appropriate. To answer the evaluation questions, data that is disaggregated and analyzed by sex will be used whenever such data are available. The evaluation Design is included in Annex B.

This evaluation takes a Theory-Based approach to evaluation[1], by which it examines the Theory of Change (ToC) that the program assumed (or should have assumed) in its design and how it was expected to produce its results. The evaluation, therefore, will enquire whether such theory existed at project design and inception, or has been somehow implicitly in place, and then will revisit it to explain how the program should have been expected to bring about the desired results.

Based in relevant literature, the evaluation analyzes the projects' logical frameworks to revisit their Theory of Change and assumptions which makes a foundation to determine the effectiveness of the projects, as well as their cost-benefit results. This approach, is complemented by a participatory process involving program stakeholders in planning, executing, delivering and dissemination of the evaluation findings and recommendations.

Within the mixed-methods approach, the evaluation includes a Cost-Benefit Analysis (CBA) intended to identify and quantify the social and economic costs and benefits of the projects. The full cost-benefit analysis is included as Annex E

As training is one of the largest components of both programs, and OAS-DSD used the Kirkpatrick model of Training Evaluation2, this evaluation enquires how it was utilized, with what results, and how it led to decisions for program improvement, which is reflected in both the design of data collection methods and data analysis. Clearly, evaluating the learning of programs' trainees is far out of the scope of this evaluation, however, among the four levels of the Kirkpatrick method, "Level 4: Results" concurs with and will support this evaluation conclusions.

Likewise, the ET uses its background on gender equality to ensure that a gender lens is applied to all data collection methods and the evaluation overall.

Data analysis, as well as conclusions and recommendations are based on evidences stemmed from the various data collection methods, which include Document and literature review (DR) an Online Survey (OS), Key Informant Interviews (KII) and a Case Study (CS) all conducted online. Findings do not include any evaluator's opinions o perspectives. Conclusions and recommendations are largely based on the findings. The data collection tools used are included in Annex B, a list of the people interviewed is in Annex C and the documents and literature reviewed are in Annex D.

2.1. Evaluation questions and evaluation criteria

This evaluation focuses on answering the following evaluation questions (EQs) that OAS has postulated:

1. Were the output and outcome indicators achieved? If not, explain why.

[1] https://www.canada.ca/en/treasury-board-secretariat/services/audit-evaluation/centre-excellence-evaluation/theory-based-approaches-evaluation-concepts-practices.html#toc4

[2] Kirkpatrick's Four Levels of Training Evaluation. James S and Wendy Kayser Kirkpatrick. ATD Press, 2016.

2. Were the results achieved attributable to the actions of the operation?
3. If empirical attribution cannot be stablished, is there a robust theoretical attribution?
4. Did the project's team apply results-based management principles from its inception to its conclusion?
5. Were lessons learnt identified during the implementation of the projects?
6. Was the monitoring mechanism used as an efficient and effective tool to follow-up on the progress of projects' actions?
7. Were there any unforeseeable/not planned results or outcomes?

To answer the EQs, the ET:

1. Conducts a formative and summative evaluation to assess the projects' progress in achieving its objectives.
2. Determines, to the extent possible, the effectiveness of the project as best reflected in the available results to date.
3. Critically analyzes the formulation, design, implementation, and management of the projects and make recommendations as needed.
4. Conducts a cost benefit analysis by determining the internal rate of return and net present value of the investment.
5. Assesses the likelihood of institutional and financial sustainability of the interventions financed by the projects.
6. Documents lessons learned related to the formulation, design, implementation, management, and sustainability.
7. Makes recommendations, as appropriate, to improve the formulation, design, and implementation for future similar interventions.
8. Assesses if and how the projects addressed the crosscutting issue of gender perspective and to what results.

Answers to the EQs are sought within the framework of the following evaluation criteria: i) relevance, ii) attribution, iii) effectiveness, iv) efficiency, v) sustainability, vi) "gender approach". A succinct definition of each and all evaluation criteria appears on the corresponding section of the evaluation report.

3. Relevance

"The extent to which the intervention objectives and design respond to beneficiaries', global, country, and partner/institution needs, policies, and priorities, and continue to do so if circumstances change." this is how the Organization for Economic Co-operation and Development (OECD) defines Relevance as an evaluation criteria[3]. Document review as well as KIIs were instrumental to understanding the relevance of M4EE and M4SET.

Global, regional, and country relevance

According to prodocs, the projects further the U.N.'s 2030 Agenda for Sustainable Development, especially Goal 7, and target 13.2 of Goal 13[4]

[3] OECD/DAC Better Criteria for Better Evaluation. 2019. Revised evaluation criteria definitions and principles for use. 2019

[4] Goal 7: Ensure access to affordable, reliable, sustainable, and modern energy for all.
7.1. By 2030, ensure universal access to affordable, reliable, and modern energy services.
7.2. By 2030, increase substantially the share of renewable energy in the global energy mix.
7.3. By 2030, double the global rate of improvement in energy efficiency.
7.4. By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.

Likewise, At COP 21 in Paris, parties to the U.N. Framework Convention on Climate Change, including the 32 countries in Latin America and the Caribbean, reached a landmark agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. In the Americas, meeting these goals requires the concerted action of OAS Member States to increase energy efficiency, expand the use of renewable energy, and improve air quality.

Although an analysis of the specific alignment of the projects and its activities with national public policies related to energy efficiency, energy quality or air quality exceeds the scope of this evaluation, there is evidence that MA4SET and M4EE either contributed to the formulation of public policies, such as the lighting RTCA in Central America or to a better implementation of policies already in place by providing more accurate measurements that strengthened the application of such policies (e.g. air quality in Argentina or Colombia)

The development of the renewable and energy efficient technologies requires a robust metrology infrastructure with measurements and standards in place. Metrology also has a critical role to play in understanding, modeling, and monitoring climate change as well as to advance towards more efficient systems and technologies. However, most of countries in the Americas still lack of many technical and technological capabilities important to implement climate policies and measures, and clean and efficient use of energy. National Metrology Institutes in the Americas along with other technical organizations involve in energy and climate fields need to develop robust metrological capabilities in energy and climate science (e.g., air quality monitoring, energy efficiency performance, GHG emissions measurement, accurate traceability, calibration, etc.) to be able to assess progress toward the achievement of targets set in COP21.

MA4SET and M4EE aimed to improve the understanding and application of metrology in the fields of climate change, energy efficiency and renewable energy through training and awareness of relevant high-ranking government officials and technical stakeholders. Training and technical assistance was delivered through knowledge sharing, best practices, technical exchanges, and regional cooperation. These actions sought to contribute to greater involvement of the metrology community in climate and energy and ultimately will contribute to support the deployment of sustainable energy technologies and foster low carbon economic growth in the Americas.

Relevance for OAS and the donor

According to their prodocs, M4EE and M4SET, align themselves with a sizable number of OAS policies and declarations such as those from the OAS General Assembly, the Interamerican Council for Integral Development (CIDI) and similar programs such as the Energy and Climate Partnership of the Americas (ECPA) which aims to promote regional energy cooperation through different strategies and actions for achieving a cleaner, safer, efficient, modern and fair energy deployment.

7.5. By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programs of support.
Goal 13: Take urgent action to combat climate change and its impacts.
13.2. Integrate climate change measures into national policies, strategies, and planning.

For the U.S. Government, Latin America and the Caribbean is a highly relevant region as it seeks an active engagement in aspects ranging from promoting air quality improvement, prompting energy security, prosperity, trade, and regional integration within the Western Hemisphere.

Relevance and projects' implementation

In addition to the overall global, regional, and country relevance of the projects, M4SET and M4EE adopted an implementation modus operandi that by design guaranteed the relevance of their specific activities. Instead of being the OAS or NIST who determined what specific activities would the project carry out, it were the countries (often in groups), and their related stakeholders who determined, through the mechanism of "proposals", what their needs, policies or priorities were, and what kind of awareness-raising, training, technical exchange or technical assistance, or a combination thereof, they wanted to have supported by the projects. Although not all proposals were successful in doing so and, therefore, were never approved, most were well structured and became project activities related to either energy quality, energy efficiency or air quality. Through the "proposals" mechanism, not only relevance was clearly embedded in project implementation, but also the commitment, collaboration, and often, resources of project beneficiaries were actively assured.

Relevance for the beneficiaries

While the vast majority of survey respondents (96 percent) rated the relevance of the projects as "high or very high". Interviewees referred to projects' relevance in various ways. One of them stated: *"(The project)..was able to look at our needs, and not just give us some blanket project that was just handed out, which is something we often have that challenge with development partners and their assumptions about the region",* while another one made a more nuanced statement about LAC countries: *"Everyone was invited to participate, not everybody chose to, either they don't have activities going on in this areas or they don't have the internal government support to develop this capabilities, because this is not an aid project where they get a lot of money, they are getting some technical assistance to develop, but if they don't have the support of their governments to provide the resources internally, it's hard to engage. That is often a challenge for the smaller countries"*

Moreover, projects' relevance was ensured by the design of their activities as attested by 92% of survey respondents who scored the design quality of the activities as high or very high, which means that they clearly responded to their needs, policies, and priorities. This evaluation finding concurs with the results of internal evaluation and follow up activities (surveys, talks, meetings) carried out by the implementation team which consistently confirmed that stakeholders had experienced an increase in their knowledge of the technical matters addressed by projects activities whether they were training, technical exchanges or technical assistance.

Evidence found by this evaluation consistently confirmed the relevance of M4SET and M4EE for local, national, and regional stakeholders. High relevance, in this case, positively contributed to projects' effectiveness, as discussed elsewhere in this report.

4. Effectiveness

OECD defines effectiveness as "the extent to which the intervention achieved, or is expected to achieve, its objectives, and its results"[5] Regarding objectives and results, the OECD notes that analysis of effectiveness "involves taking into account of the relative importance of the objectives or results"

[5] OECD Better criteria for better evaluation

To determine the effectiveness of M4SET and M4EE, the evaluation starts by determining what activities were implemented by the projects, then reviewing how such activities reflect themselves in terms of project performance indicators so that based on those examinations, as well as theory-based considerations, then it proposes a Theory of Change which provides a greater comprehension of project's effectiveness while supporting establishing factors that favored or impeded projects' achievements, including project management. Finally, it examines the occurrence of unanticipated results, if any.

4.1. Activities implemented

Table 1. M4SET & M4EE Activities (as of October 14, 2020)

M4SET & M4EE Activities (as of October 14, 2020)				
No	Project Title	Type	Date	Location
1	International Metrology Cooperation in support of Energy & Environment (ECPA Side event)	Awareness	September 7-8, 2017.	Vina del Mar, Chile
2	Workshop on Acoustics, Ultrasounds and Vibration for Wind Energy	Technical Exchange	November 8-10, 2017	Rio de Janeiro, Brazil
3	Technical Exchange on Energy Efficiency Testing for Refrigerators and Air Conditioners	Technical Exchange	April 2 to 20 of 2018	Mexico City, Monterrey (Mexico)
4	Regional Workshop - Metrology Support for the Quality Assurance of Measurements of Air Quality Monitoring Networks	Technical Exchange	June 5 to 7, 2018	San Jose, Costa Rica
5	Energy Efficiency Tour - Intertek	Conference/Workshop	June 19 to 22, 2018	Cortland, New York
6	International Forum for Sensitization on Environment, Energy and Public Health	Awareness/Training	October 11 and 12, 2018	Queretaro, Mexico
7	39th Meeting of CCQM- Gas Analysis Working Group and Workshop on Advancing the State of the Art in Measurement Science (CCQM-GAWG) Metrology Symposium.			
8	Technical Exchange on the Development of a Solar Simulator (UV irradiance levels)	Technical Exchange	February 26 27, 2019	Queretaro, Mexico
9	Capacity Assessment Refrigeration and Air Conditioning Laboratories at the Bureau of Standards of Jamaica (BSJ)	Technical Assistance	June 11 to 13, 2019	Kingston, Jamaica
10	Workshop for Strengthening Air Quality Monitoring in Latin America	Training	August 26-29, 2019	Mexico City, SEDEMA Labs
11	Technical Exchange on energy quality between the National Metrology Institutes of Ecuador, Colombia, Mexico, Uruguay, and Brazil.	Technical Exchange	October 2018 to June 2019.	5 successive hands-on trainings in Querétaro, Montevideo, Bogota
12	Building Resilient Infrastructure IV ECPA Ministerial	Awareness	February 26 and 27, 2019	Montego Bay, Jamaica
13	Exchange - SIM XXIII General Assembly	Awareness	September 24-28, 2018	Gaithersburg, MD
14	Capacity Assessment energy efficiency testing of lighting at the Trinidad and Tobago Bureau of Standards TTBS	Technical Assistance	Ongoing	Remote Assessment
15	Strengthening technical capacities in quality control for air quality monitoring networks in Latin American cities	Technical Exchange	Ongoing	

M4SET & M4EE Activities (as of October 14, 2020)				
No	Project Title	Type	Date	Location
16	Technical Exchange between Panama and Honduras	Technical Exchange	December 11-22, 2017.	INM Panama City
17	Inter-comparison between ICE (Costa Rica) and NIST (USA) on High Resistance	Technical Exchange	2018	Intercomparison.
18	Technical Workshop and Presentation of Recommendations to the RTCA and PEC: SICA Member States	Training	March 25 and 26, 2019	Guatemala
	29th Quadrennial Session of the International Commission on Illumination (CIE) SICA Technical Group on Energy Efficiency (GTEE)	Awareness		Washington, DC
19	"Enhancing Energy Efficiency Lighting Standards in Central America: Presentation of technical notes and workshop"	Training	November 6 and 7, 2019	San Salvador, El Salvador
20	Benefits and opportunities of harmonizing lighting standards in SICA countries	Awareness	February 27, 2020	Jamaica
21	Fortalecimiento de Estándares de Eficiencia Energética en Iluminación- Taller de Cierre	Training	May 13, 2020	Remote
22	NIST Expert´s presentation to Conference/Workshop in SIM Week Costa Rica: “Advances in the Physicochemical Characterization of Nanoparticle Suspensions using Single Particle Inductively Coupled Plasma Mass Spectrometry: An Overview”	Technical Exchange/ Workshop	April 3-5, 2019	San Jose Costa Rica

Overall, the projects implemented six awareness activities, eight technical exchanges, seven training and two technical assistances of which the vast majority, eighteen, related to energy quality and or energy efficiency.

4.2. Performance indicators

Table 2. M4SET Performance indicators

Purpose	Indicators at the level of Purpose	Baselines	Targets	Actual data	Performance %
To strengthen the technical and technological capabilities of the metrology community, government officials and other technical stakeholders in the fields of energy efficiency, renewable energy, air quality and greenhouse gases in beneficiary countries.	At least 4 initiatives/actions on energy efficiency, renewable energy, air quality and greenhouse gases in beneficiary countries report progress at the end of the project.	0	4	18	450%
Outputs	**Indicators at level of Outputs**	**Baselines**	**Targets**	**Actual data**	**Performance %**
High-ranking officials mindful of the value of metrology applications for advancing greenhouse gas emissions reduction and air quality monitoring and improving measurement infrastructure for sustainable energy development in the Americas.	By the end of each forum (activity 1.2), at least 80% of participants (Men/Women) consider that it is important to include metrology science in the design and implementation of sustainable energy initiatives.	0	80	100	125%
	By the end of the project, at least 7 technical exchanges or concrete collaboration actions are agreed among countries of the region.	0	7	12	171%
Government officials from ministries of energy, environment, energy, commerce, national metrology institutes, accreditation and normalization bodies and academia increased knowledge in measurement sciences applied to air quality, greenhouse gas emissions, and renewable and efficient energy standards	By the end of the project, at least 80% of participants (Men/Women) of technical exchanges and trainings report they increased their knowledge.	0	80	98.20	122%
	By the end of the project, at least 70% of host trainers/institutions report through the final evaluation that the participant increased their knowledge.	0	70	100	142%
	By the end of each in-depth technical training or exchange, at least 70% of participants (Men/Women) answer correctly 75% of the questions in the knowledge test.	0	70	NA	NA
Project planning, monitoring, administration, and dissemination of results executed.	By the end of the project, at least 7 half- yearly reports and 1 final report are submitted to the donor and the OAS/DPE using the format established by the latter.	0	7 half year reports and 1 final report	7	100

Table 3. M4EE Performance indicators

Purpose	Indicators at the level of Purpose	Baselines	Targets	Actual data	Performance %
	At least 3 actions/projects on energy efficiency's measurement and conformity assessment for equipment and appliances report progress at the end of the project.	0	3	3	100%
	One proposal on energy efficiency measurement and conformity assessments for equipment and appliances presented to high ranking officials in the energy sector by the end of the project.	0	1	6	600%
Outputs	**Indicators at level of Outputs**	**Baselines**	**Targets**	**Actual data**	**Performance %**
High-ranking officials in Central America and Dominican Republic mindful of the value of metrology to address energy efficiency policymaking for household air conditioners, refrigerators, lamps, and electric motors.	At the end of each forum (activity 1.2), at least 80% of participants consider that it is important to include metrology science in the design and implementation of energy efficiency regulations.	0	80	100	125%
Technical experts from ministries of energy, environment, energy, commerce, national metrology institutes, accreditation and normalization bodies and academia in Central America and Dominican Republic increased knowledge in energy efficiency performance and measurement standards and testing protocols for equipment and appliances.	By the end of each in-depth training or technical exchange, at least 70% of participants (Men/Women) answer correctly 75% of questions in knowledge test.	0	70	0	NA
	By the end of the year, at least 80% of participants (Men/Women) of technical exchanges and trainings report they increased their knowledge	0	80%	100	125%
	By the end of the project, at least 70% host trainers/institutions report through the final evaluation that the participant increased their knowledge.	0	70%	100	142.8%
Project planning, monitoring and evaluation.	By the end of the project, at least 7 half- yearly reports and 1 final report are submitted to the donor and the OAS/DPE using the format established by the latter.	0	7 half year reports and 1 final report	7	100%

A review of the projects' performance indicators shows strong effectiveness performance by all accounts. As per the definition of effectiveness above, not all results are equal and therefore the relative importance of objectives and results must be taken into consideration.

Consequently, the indicators of projects' purpose are the most important of all and the two projects met or exceeded measures of the attainment of their purpose of strengthening the technical and technological capabilities of the metrology community, government officials and other technical stakeholders in the fields of energy efficiency, renewable energy, air quality and greenhouse gases in beneficiary countries. Likewise, the indicators related to project's components or activities were all met or exceeded.

The evidence of positive projects' effectiveness given by the performance indicators has been enthusiastically corroborated (particularly in the technical-technological aspect of the projects) by their stakeholders as 81 percent of survey respondents considered that the projects have achieved their objectives and results and, therefore, scored their effectiveness high or very high. Likewise, 93 percent of survey respondents agreed or highly agreed that the technical capacities of the metrology community in their countries were strengthened by the projects. The effectiveness of the projects in beneficiary countries' adoption of new public policies, however, is less clear for survey respondents as 63 percent declared themselves neutral or disagreed that the projects have yet influenced the public policies in their countries.

An area where survey respondents scored the projects significantly lower and that is their contribution to the adoption of low carbon energy technologies. In this regard, while 41 percent of survey respondents agreed or highly agreed that such attribution exists, 30% declared themselves neutral.

There were some performance indicators (e.g , M4SET: at least 10% of workshop and seminar speakers are women or at least two high level forums address gender issues and the role of women in the advancement of sustainable development and the environment) that changed overtime as the logframe of the projects evolved, as well as other performance indicators that for various reasons were not followed up throughout the project (e.g M4SET: by the end of each technical training, at least 70% of participants answer correctly 75% of the questions in the knowledge test). This finding invites to a reflection on some indicator's usefulness and the degree in which not only there is a common and accepted understanding of them, but they are S.M.A.R.T. indicators.[6]

4.3. Theory of Change revisited

A Theory of Change (ToC) is basically defined as "a theory of how and why an initiative works"[7]. A TOC provides an overarching picture of the project's intended pathway of change, explaining how the intervention is expected to interact with other concurrent interventions and contextual conditions to enable a series of outcomes at various levels of an objectives hierarchy, including intermediate results, strategic objectives, and project goal. In evaluation ToC articulate expected process and outcomes and allow projects to assess their contribution to change.[8]

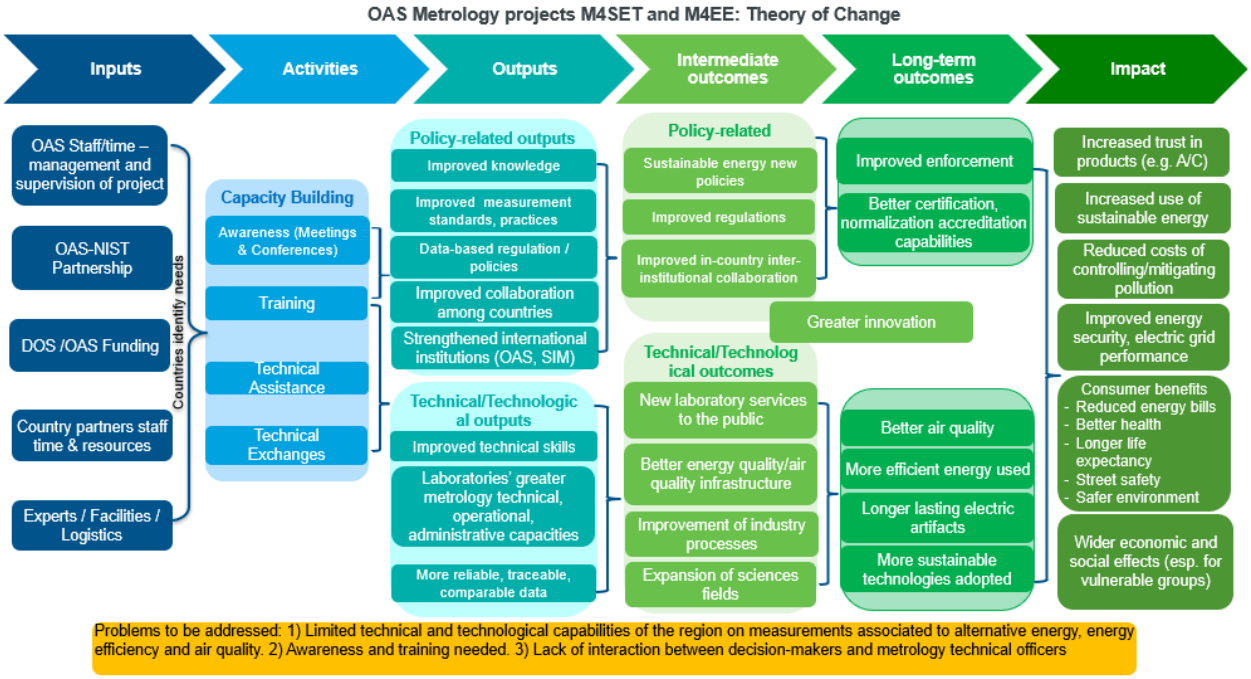
While a logframe illustrate program implementation-level understanding of a change process, the ToC gives the "big picture" of social processes that lead to change and so, for evaluation purposes, reconstruct or revisit a projects' ToC is a powerful tool to understand its effectiveness.

[6] **S**pecific, **M**easurable, **A**chievable, **R**elevant, **T**imely. Bours: A good start with SMART Indicators. 2014
[7] Carol Weiss. Evaluation Research: Methods of Assessing Program Effectiveness, 1972
[8] Stein and Water. Understanding Theory of Change in International Development 2012

M4SET and M4EE revisited ToC is based in the project's documents, logframes, documents produced by the projects, such as those from CLASP, a consultation with both the implementing team and beneficiaries and related empirical evidence. Figure 2 depicts the revisited ToC.

The Theory of Change, as revisited, uses an overarching approach that not only combines M4SET and M4EE but recognizes that each proposal has its own specific ToC. "Proposals" as called by the stakeholders are actually subprojects, initiatives related to metrology and either air quality, energy quality or energy efficiency, that are conceived by the participating countries (or a group of them), studied and approved (or disqualified) by the implementation team, and then executed by all those involved.

Figure 2. Outcomes-based M4SET & M4EE Theory of Change



ToC Narrative

Problems identified

The M4SET and M4EE projects effectively identified the problems surrounding metrology as a scientific tool to contribute to the adoption of sustainable energy technologies and foster low carbon economic growth in the Americas. They did so in two stages: the first, as the background and justification for designing the projects and focusing them in the fields of air quality, energy quality and energy efficiency, and the second as a way to decide what specific activities to be undertaken during project implementation.

The main problems, identified before projects' inception, remained valid during their implementation and beyond: they are: i) in LAC metrology is not actively used to determine air or energy quality and improve it, ii) measurement and compliance standards are needed to assess the quality of any resource, product or technology, including air and energy, iii) most Latin American countries have insufficient technical capacities to develop standards, reference materials and practices for measurement and equipment calibration, iv) while many countries in LAC have some energy and climate policies in place, most of them struggle implementing them

due to the absence of adequate metrological infrastructure, v) In LAC there is a generalized disconnect between regulatory agencies and metrology institutes and no coordination as to how to tackle the standards and measurements challenges associated with renewable energy and climate change.

ToC Assumptions

M4SET and M4EE sensibly made several assumptions thought to be preconditions for their success. They, as long as other factors identified elsewhere in this evaluation are still valid i) governments remain interested in strengthening their measurement infrastructures to support green technology development and monitoring, ii) energy efficiency continues to be a priority topic for Central America and Dominican Republic, iv) agencies are interested and support the implementation of the projects that emerge from the technical exchanges, v) Focal Points participate actively in the planning of project activities, follow up on activity outputs and provide information regarding priorities and needs, vi) there are no administration changes in beneficiary countries, or such changes do not delay or obstruct project execution.

It must be noted that most of those assumptions relate to people and institutions interest or willingness; however, project implementation showed that there are many other variables playing a role in their ability to succeed, among them considerations such as countries' lack of funds to improve metrology infrastructure, metrology being a low priority in countries' development agendas, diverging political interests to advance regional solutions, among others.

Change pathways from outputs to impact

This ToC considers the fact that both M4SET and M4EE are composed of two key aspects: a technical/technological perspective in one side, and a policy/institutional component on the other side and those aspects permeate, one way or another, the nature of each specific project activity. Therefore, this ToC assumes them not separately but intertwined which means that, for instance, certain activity at the same time might enhance laboratory-level capacities but also to feed institutional policy determinations.

Likewise, prodocs, as well as program monitoring and follow up implementation, clearly identified and classified the nature of M4SET and M4EE activities as 1) awareness, 2) training, 3) technical exchanges and 4) technical assistance. However, this ToC recognizes that project implementation was actually not merely based on that clear-cut classification, but in a more synergistic and nuanced approach under the name of "proposals". Proposals are initiatives that could comprise, for example, some training and a technical exchange, or technical assistance and training, and so on.

Although the projects, indeed, identified their beneficiaries as direct beneficiaries (ministries, INMs, metrology Institutions, normalization and accreditation organizations) and indirect beneficiaries (people of the Americas, "private sector stakeholders engaged in the promotion of renewal energy"), this revisited ToC emphasizes that difference, particularly in terms of cost-benefit analysis, to envision beneficiaries as i) consumers, ii) businesses, iii) government, a perspective that beyond specific project activities embraces a greater appreciation of projects' intermediate and long term outcomes and expected impacts.

Although the revisited ToC highlights causality pathways between projects' actions and results (attribution), it also recognizes that there many confounding factors to achieve the outcomes and impacts for the beneficiaries, ie consumers, businesses, and government. These include other government policies, decisions by private sector individuals, changes in weather pattern and more – including events such as the ongoing pandemic.

The forgoing assumptions explain why the more longer-term the outcomes are, the less clear becomes the differentiation between technical-technological components, policy-institutional components, and other influencing (compounding) factors. A technical advancement, as driven by M4SET and M4EE can potentially lead to combining technological, economic, environment or social effects. Likewise, they explain why some causal pathways are not necessarily as pristine as "output A causes outcome B", but in many cases "D is caused by A, B, and C."

As M4SET and M4EE drive behavioral change and organizational performance, institutions are enabled to implement, monitor, and enforce policies which ultimately improve economic outcomes and quality of life. The revisited ToC draws out and necessarily simplifies these links.

The revisited ToC reinforces the projects' performance indicators as well stakeholder's testimonials that evidence M4SET and M4EE as effective projects as they were able to achieve its intended objectives and results.

4.4. Projects' implementation usage of Results-Based Management (RBM)

The evaluation ToR asks three evaluation questions related to project management: i) Did the projects' team apply results-based management principles from its inception to its conclusion? ii) Was the monitoring mechanism used as an efficient and effective tool to follow-up on the progress of projects' actions? iii) Were lessons learnt identified during the implementation of the projects? The short answer to all of them is yes as discussed below.

RBM is a management strategy by which all actors, contributing directly or indirectly to achieving a set of results, ensure that their processes, products and services contribute to the achievement of desired results (outputs, outcomes and higher-level goals or impact). The actors, in turn, use information and evidence regarding actual results to inform decision-making on the design, resourcing and delivery of programs and activities. This information and evidence are also used for accountability and reporting. The three core principles of RBM are: i) Ensure that adequate and reliable results information is available when needed, ii) Use results information to inform planning and reporting, iii) Practice learning and adaptive management, using results information[9].

This evaluation found ample evidence that not only the project's implementation team was aware and trained on RBM, but it applied it from projects' inception to closing. There are plenty of examples:

- Project design was based on a previous project that called for specific results to be achieved on the policymaking and the technical side of metrology. Metrology, in turn, was held as a means to pursue higher environmental goals.
- The Prodocs were conceived by whom would be the project manager. This helped to keep projects' goals in mind throughout lifecycle.
- This evaluation had access to plenty of information the projects produced for implementation, monitoring, reporting, decision-making. A great deal of such information came from projects' beneficiaries, which ensured the relevance of the projects as well their effectiveness and attribution.

[9] United Nations Population Fund (2019). *Results-based Management Principles and Standards: The 3+5 Framework for Self-Assessment*. New York, New York.

- Information on projects' implementation and results was used to support permanent consultative process between the implementation team and stakeholders which, in turn helped to shape decisions that favored achieving results.
- Project implementation was "proposal-based" which led the implementing team to practice adaptive management[10] as circumstances changed over projects' lifecycle (eg the COVID-19 pandemic and the countries' renewed interested in air quality measurement).

As implied above, the project's monitoring mechanism was used constantly and effectively as:

- There was a continuous collaboration between the project implementation team and OAS-DPE regarding a wide variety of subjects such a performance indicators' definition and utilization, adoption of the Kirkpatrick model of training evaluation, utilization of surveys to monitor and evaluate activities' effects, reporting, means of verification, etc.
- The utilization of the Kirkpatrick model reinforced project's monitoring of project's effects from the immediate ones (reaction and learning) to more lasting ones (behavioral change and change in organizational performance).
- The project manager carried out several internal evaluations of projects' activities which beyond logframe performance indicators, sought to determine and document the actual outcomes and impact of the projects in those individuals and institutions involved.
- Project monitoring helped to shape the nature and scope of projects' activities, through proposals and their implementation) in a process of continuous learning from experience, from the beneficiaries, and the circumstances. This was valued and appreciated by beneficiaries as conveyed by a KII: "A merit of the project is that it was developed by stages, each one building on the experience of the previous one. That increased opportunities for our institute to gain experience and advantage form the program".

Using RBM and successful monitoring mechanisms, necessarily required and led to the identification of lessons to be learned and acted up in continuous basis.

4.5. unforeseeable/not planned results or outcomes

Three major unanticipated results M4SET and MA4EE achieved were:

- The creation of a LAC-wide community of practice, a network of individuals invested in metrology for energy and air quality who have gone beyond projects' activities to become a group of individuals who resort to each other for information, guidance, support, and exchange of experiences. Such personal relationships have also institutional effects as the organizations those individuals work for benefit from the exchange. This unplanned result is highly praised and valued by those involved.
- The extent to which several countries committed themselves to the success of projects' activities was unanticipated. Those countries exercised leadership in the design, organization, implementation, and even partial co-funding of several project's activities at a point that the implementation team played more a role of support and guidance.
- The occurrence of the COVID-19 pandemic negatively affected the rhythm and scope of the projects' activities during their last year. Several laboratory-based hand-on training and technical assistance activities had to be either cancelled. The projects' tried to adapt by moving to a remote format. Some KII believe that this misfortune opened an opportunity to explore the potential of online learning and remote collaboration.

[10] USAID Learning Lab (www.usaidlearninglab.org) defines adaptive management as "an intentional approach to making decisions and adjustments in response to new information and changes in context. Adaptive management is not about changing goals during implementation, it is about changing the path being used to achieve the goals in response to changes"

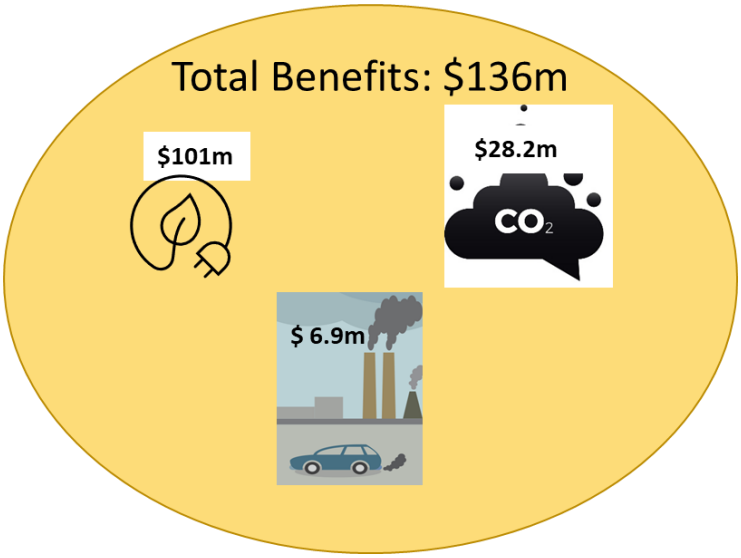
5. Cost-benefit analysis (CBA)

CBA is a policy assessment method that quantifies in monetary terms the value of all consequences of a policy to all members of society. The broad purpose of CBA is to help social decision-making and to increase social value or, more technically, to improve allocative efficiency. CBA applies to policies, programs, projects, regulations, demonstrations, and other government interventions. CBA considers all the costs and benefits to society as a whole, that is, the social costs and the social benefits [11]

While this section presents a summary of the estimated benefits M4SET and M4EE brought to Latin America and the Caribbean (LAC), the full cost-benefit analysis is included in Annex E of this report. Furthermore, the calculations that support the CBA were submitted along with this report to OAS-DPE in a MS Excel file.

M4SET and M4EE contribute significantly to the economy and well-being of the people of Latin America and the Caribbean. In total their contribution is estimated to be US$ 136.6m at a cost of just over US$ 2.3m

Figure 3 M4SET & M4EE social and economic benefits



This means that the benefits outweigh the costs by a factor of 58, since every dollar invested leads to $58 of benefits.

The Net Present Value of the programs' benefits is $134.1m and the Return on Investment is estimated at 57.7

The main contributors to these benefits are:

- Energy efficiency in the households of $ 101m
- Increase in business productivity due to reduction in air pollution of $ 6.9m
- Reduction in carbon emissions, estimated in $28.2m.

[11] Cost-Benefit Analysis: Concept and Practice. Boardman et.al. 5th edition. 2018

M4SET and M4EE are a catalyst and enabling driver for change. Many other factors will contribute to the changes that lead to benefits, which in total are very much larger than those presented here.

In addition, there are many benefits which cannot be quantified, which include

- Increased street lighting safety
- Improved products in OAS member states manufacturing
- Rising rates of innovation in the region

An estimate of the potential positive impacts for women of improved street lighting was estimated to be more than $ 230m.

CBA Assumptions

The Cost Benefit Analysis is based on a set of assumptions related to public policymaking and its social and economic effects:

- The CBA estimates are aligned with the Theory of Change described in the section 2 of this report and empirical evidence of policy impacts from across the world.
- OAS interventions lead to organizational change that improves energy efficiency, energy equality and air quality which, in turn produce environment, social and economic impacts in the short and long terms.
- Governments keep themselves interested in policies, regulations, and technologies, including metrology, which contribute to a better environment. In parallel, there is an increased trust and confidence in standards and in using products based complying such standards.
- The quantitative analysis covers a period of 10 years (unless stated otherwise) after the desired impact has occurred. However, there is a lag between the capacity building intervention of the OAS and the implementation of measures at the country level. The quantitative analysis covers a period of 10 years (unless stated otherwise) after the desired impact has occurred. However, there is a lag between the capacity building intervention of the OAS and the implementation of measures at the country level
- Monetization of benefits, regarding energy efficiency is based in considering household and local governments savings in energy bills whereas for energy quality and air quality is based on labor force productivity. Moreover, CO2 emissions considers the carbon price of reduced emissions.
- In calculating the Net Present Value of the programs' benefits a 3.5% discount rate was used as per the British Green Book[12] whenever there not a more specific rate was available. Calculations related To SICA members lighting markets used the same discount rates used by CLASP country by country (4% - 7%)[13]
- These are estimates and therefore uncertain. However, the CBA takes a cautious approach to the identification of benefits and provides the lower boundary of a range used for calculation to avoid overestimating benefit.

[12] HM Treasury. The Green Book. Central Government Guidance on Appraisal and Evaluation. 2018

[13] CLASP. Overview of Lighting Markets in the Central America Integration System (SICA) countries. 2020

6. Efficiency

OECD defines efficiency as "the extent to which the intervention delivers, or is likely to deliver, results in an economic and timely way"[14] Efficiency as a project evaluation criteria addresses how well a project uses the resources at their disposal. Resources include time, people, technology, money, and management.

Time

Considering the projects' lifecycle, the number of activities implemented as well as their nature, it can be sustained that timewise, 4MSET and 4MEE were efficient projects. They managed to implement 22 activities in 4 years which is a remarkable number considering that i) projects never start implementing activities in day one, ii) beneficiaries, not merely the implementation staff, were a deciding factor in defining the specific nature of project activities, iii) conceiving, processing, approving, funding, organizing and implementing proposals is a time-consuming process not in control of the implementing staff, iv) proposal often involved officials subject to politics, government regulations and other constraints, v) the COVID-19 pandemic thwarted in-person international technical events planned for 2020.

Human talent

Utilization of human talent is an additional area where 4MSET and 4MEE performed efficiently. Projects' staff was comprised basically of one person, a female engineer, a consultant external to the organization who for the most part led the projects' formulation, implementation, and monitoring. However, as a project manager, she counted with the partnership and support from a female scientist from NIST. The two of them were regarded as the engine force of the project. In addition, the projects' enhanced their human resources, indirectly, with the very active participation of a number of representatives of the metrology, air quality, and energy efficiency communities from the several countries that conceived proposals and presented them to OAS for financial support through the two projects. In this regard, some KIIs wondered whether the projects could have been even more effective should they have more implementation staff.

Technology

Technology played a key role in 4MSET and 4MEE implementation as i) NIST reputation and known partnership with OAS lent extra credibility to the projects, ii) the projects were essentially technological in nature, iii) two kinds of activities undertaken by the projects: technical assistance and technical exchange were laboratory-related initiatives, iv) several hands-on activities scheduled for 2020 had to resort to virtual means to be implemented, which severely restricted their scope and possibilities.

Money

Money is an element of projects' efficiency that would require a more nuanced analysis. At first sight when each project shows a component called "project planning, monitoring, administration and dissemination of results" that amounts to 46 percent of total costs, it is difficult to justify such proportion of administrative costs[15]. Nevertheless, since this evaluation has learned from several KIIs that said share of costs comes from a set of institutional and donor considerations and arrangements that normalize it, clearly that is an aspect of efficiency that falls beyond the scope of this evaluation.

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[14] OECD. Better Criteria for Better Evaluation

[15] For reference U.N. Democracy Fund states: "The Executing Agency will normally be entitled to charge up to 7% of the Total Project Costs for its overhead cost in overseeing the project, unless otherwise advised by UNDEF. This fee must cover all financial, contractual, reporting, evaluation, and other agreed services to the project".

Management

Is worth to reiterate, as discussed on the Results Based Management section under effectiveness, that the management of the projects and its implications in terms of planning, organization, implementation, coordination, communications, monitoring, and evaluation, as well as the commitment from stakeholders, significantly contributed to an efficient utilization of projects' resources.

7. Sustainability

USAID defines sustainability as "the degree to which services or processes continue once inputs (funding, materials, etc) provided by the original source(s) decreases or discontinues"[16]. In turn, OECD defines sustainability, in a more long-term perspective, as "The extent to which the net benefits of the intervention continue or are likely to continue" and then explains that an analysis of a project sustainability "Includes an examination of the financial, economic, social, environmental, and institutional capacities of the systems needed to sustain net benefits over time" [17].

M4SET and M4EE prodocs aimed to ensure projects' sustainability by: i) engaging critical stakeholders and international organizations/programs with complementary agendas on Energy, Environment and Metrology (namely SICA in the case of M4EE), ii) Promotion of the participation of development banks and other organizations able to provide technical cooperation, iii) engagement of technical experts and policy decision-makers, iv) adoption of a training strategy composed of awareness, targeted training solutions, and technical assistance requests (proposals).

As previously stated, there are several aspects that can be examined to determine the sustainability of the projects and their effects: financial, technical, technological, institutional, political, environmental, and economic.

From the strict project financial sustainability, given that funding of the U.S. Mission to the OEA comes to an end in November 2020, M4SET and M4EE, as they have been known, won't be able to afford undertaking any more of their training, awareness, technical exchanges or technical assistance initiatives. No subsequent phase of the projects is on sight.

However, financial sustainability of activities similar to those implemented by the projects can be envisioned in the coming years, as according to stakeholders, not only during project implementation several countries, despite their financial limitations, contributed with time, staff and assuming some costs, but a few others have devoted their own resources to continue such activities as a matter of national policy. Moreover, international development organizations have approached LAC countries with interest in promoting energy efficiency among them. As expressed by a KII: "trough SICA, the International Energy Agency – IEA is willing to support us the same way the OAS has; right now, the two organizations are defining how they will cooperate".

[16] USAID. Glossary of Evaluation Terms. Planning and Performance Management Unit, 2009

[17] OECD/DAC. Better Criteria for Better Evaluation.

Technical and technological sustainability is promising as the effects of the projects in terms of acquisition of technical skills by engineers, technicians and scientists' members of the metrology, energy and air quality community in several LAC countries are tangible. Thanks to the projects they have information, knowledge, abilities, and relationships that will endure beyond projects' end. Due to such skills, they have been able to apply technologies, acquire the right equipment, understand, and apply standards, or adopt procedures that they previously were not aware of, or did not know how to use. Among other factors, a good harbinger of such potential continuity is the projects' experience since the COVID-19 pandemic started earlier this year, despite which their activities continued although they have to adapt in terms of format, content, and logistical considerations.

Another element of sustainability that is part technical and part institutional is the fact that participants in the programs' have created a peer network that in an informal way (WhatsApp) favors collaboration, experience exchange, and knowledge dissemination. KIIs praise such a network as an important tool that is a legacy of the projects for the future.

When a laboratory started a new metrology service thanks to knowledge and skills acquired from M4SET or M4EE, when two institutions (e.g. an Energy Ministry and a Metrology Institute) began collaboration after participating in project's activities, when two or more countries joined efforts to present a proposal for OAS' support, or undertook a collaborative initiative on their own, when a standard such as the RCTA on lighting is making his way to become a regional asset, in all those cases, the projects are showing institutional effects and sustainability for the years to come.

Policy and political sustainability, especially in the case of Central America, policy sustainability is being strengthened by M4EE and its support to the regional policy-making process geared towards adopting its RTCA on lighting. The same experience could very well, be used by SIECA and its members to promote the adoption of RTCAs in other areas such as A/C or electrical motors. And as a KII expressed: "anytime governments become more engaged in the sub regional way to try and achieve common goals, it only increases their governance capacities more generally, on these technical issues, and it also how they engage on less technical issues".

Due to its low first cost, rapid turn-over and high energy savings potential, lighting represents one of the best products for setting quality and performance product regulations. Over the last decade, lighting technology has improved significantly, transitioning from wasteful lamp technologies like incandescent, halogen and fluorescent lamps to more efficient and sustainable lighting technologies like light emitting diode (LED) lamps and luminaires.
Today's LED lighting products are affordable, widely available, and offer 90% energy savings compared with incandescent lamps. Consumer payback periods are often less than a year and, in some cases, only a few months. Additionally, while the market interest in LED products continues to grow, many governments lack quality and safety standards for these lamps and luminaires. With the right regulatory framework in place, governments can accelerate the market transformation to efficient lighting and ensure the availability of high quality, affordable LED lamps and luminaires. Furthermore, harmonizing and increasing the stringency of energy efficiency standards and labels (S&L) for lighting in SICA can benefit power grid stability, energy security and economic development (CLASP 2020)

KIIs, on the other hand, note that elections, personnel turnover, insufficient budgets, and indifference from the leadership at policy-making institutions, affect the implementation of changes and the overall advancement of metrology as a tool for energy efficiency and air quality.

The environmental sustainability of M4EE and M4SET is not only the project's justification but also it is at the center of their objectives. These projects indeed, are metrology projects, however, metrology as a science, -through energy quality and efficiency, as well as air quality- is the means to "support the deployment of sustainable energy technologies and foster low carbon economic growth in the Americas" (M4SET) and to "contribute to a sustainable energy policy development in Central America and Dominican Republic" (M4EE). The environmental sustainability of this projects given their own nature, it essential to them.

Similarly, the economic sustainability of the projects' initiatives looks promising, not only because at their core they aim to promote quality and efficiency in energy and air, but particularly in the case of Central America, as determined by CLASP because "the energy savings potential in monetary terms – i.e., lower electricity bills for households, businesses and municipalities - for introducing lighting MEPS across all the SICA countries was found to be US$257 million"[18].

Back to the sustainability strategy proposed by the projects' design, there is an element that seems to be missing: participation of development banks (eg IADB or CAF). As the prodocs correctly stated, their scope only addresses the strengthening of technical capabilities, "next step will require investments in technology, metrology labs and equipment. Development banks are especially important in this process due to their ability to fund sustainable energy infrastructure and technology". This evaluation, however, found no evidence of development banks in these projects' implementation.

Overall, as indicated, project's sustainability, both in terms of their effects after conclusion, and in the longer-term, is positive and encouraging.

8. Gender perspective

The ToR asks the evaluation to assess if and how the projects addressed the "crosscutting issue of gender perspective" and to what results.

Under the section titled "Gender Mainstreaming and Metrology", the prodocs address gender and women by considering that: i) climate change affects differently women and men and, ii) there is a low participation of women in science, technology, engineering and mathematics (STEM), and so, the projects declare that they will i) promote "gender equality, diversity and inclusion", ii) adopt selection criteria for activities to foster participation of women, and iii) encourage the inclusion of a gender diverse group of partners dedicated to the advancement of climate science and technology standards and measurements.

From a theoretical side, the foregoing declaration of projects' intentions reflects a laudable but convoluted approach that mixes up related, but clearly differentiable concepts: gender

[18] CLASP. Overview of Lighting markets in the Central American Integration System (SICA) countries. April 2020

mainstreaming[19], gender equality[20] and women in STEM[21], which makes it difficult to foresee what the implications of those concepts for project outcomes might be, except for the general statements in the above paragraph.

Moreover, a review of the projects initial logical frameworks reveals that e.g. M4SET, although does not mention women among its goal, purpose or outputs, it does include an indicator defined as the implementation of "at least two high level forums (sic) address gender issues and the role of women in the advancement and the environment". Such indicator would be dropped in a latter revision of the project logframe. Information from the program, as well as KIIs indicate that in some events that it took part of, such as Ministries meetings, the subject of women in the environment was tangentially addressed, this evaluation, however, did not find evidence that the program organized or hosted such fora. The same observation applies to M4EE.

To fully assess the role of gender mainstreaming in the projects, on the other hand, it must be considered, again, not only that they operated "on demand", i.e. based on the needs and requests from OAS members and therefore they undertook mostly the initiatives proposed by them, which did not happen to include gender mainstreaming, but also that the projects' proposal application packages adopted three criteria -which did not explicitly include gender mainstreaming- for the proposal to be considered: i) relevance, ii) technical objectives and expected outcomes, and iii) organization and arrangements.

However, there are plenty of evidence that both OAS-DPE and OAS-DSD made a concerted and continuous effort to gender-disaggregate project's information such as records, surveys, follow up activities, etc.

Moreover, even though projects' stakeholders did notice and praised an active participation of women in M4SET and M4EE activities, including notable women's leadership in designing and implementing them, during KIIs they were unable to identify concrete project's objectives directly related to women mainstreaming, or as conveyed by a KII: "did we think about it (*gender*) at the beginning (*of the projects*)? Yes!, but it is always challenging, because the link that we saw was more at the end-user level, like the impact of the weaker energy efficient devices on the lower income, especially heavily women led households, single family households. But in the point of the technical assistance into the project, we did not see it directly, having a role".

In conclusion, to answer the evaluation question, it can be said that the projects did address the gender perspective by mentioning it in the projects' prodocs, and by gender-disaggregating

[19] United Nations Economic and Social Council ECOSOC, 1997. Gender mainstreaming is "the process of assessing the implications for women and men of any planned action, including legislation, policies or programmes, in all areas and at all levels. It is a strategy for making women's as well as men's concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of policies and programmes in all political, economic and societal spheres so that women and men benefit equally and inequality is not perpetuated. The ultimate goal is to achieve gender equality."

[20] USAID Gender Equality and Females Empowerment Policy 2012, where Gender Equality "concerns women and men, and it involves working with men and boys, women and girls to bring about changes in attitudes, behaviors, roles and responsibilities at home, in the workplace, and in the community. Genuine equality means more than parity in numbers or laws on the books; it means expanding freedoms and improving overall quality of life so that equality is achieved without sacrificing gains for males or females"

[21] AAUW. The STEM GAP https://www.aauw.org/issues/education/stem/ Women in STEM refers to the gender disparity in the fields of science, technology, engineering, and mathematics which are construed as well-compensated, high-status professions with universal career appeal, but are predominantly male.

participants' information throughout projects' lifecycle. Otherwise, no project results on gender mainstreaming could be evidenced[22].

9. Case study

Improving Air Quality Monitoring in Latin America

The case of M4SET an OAS-NIST Program

Background

Implemented by the OAS in partnership with NIST, between 2016 and 2020, and funded mostly by the U.S. Government, the program "Advancing Metrology for Sustainable Energy Technologies and the Environment in the Western Hemisphere" (a.k.a. M4SET) aimed to support the deployment of sustainable energy technologies and foster low carbon economic growth in the Americas by strengthening the technical and technological capabilities of the metrology community, government officials and other technical stakeholders in the fields of energy efficiency, renewable energy, air quality and greenhouse gases.

Unlike many other international development projects, M4SET distinguished itself by operating "on demand", meaning that its specific activities were not rigidly predetermined from projects' inception, but, in a needs-based approach, they were conceived and proposed by its intended country beneficiaries which, often jointly, defined their technical scope, nature, expected results, as well as their organizational and logistical features. Such activities were a mix of awareness raising, training, technical assistance and/or technical exchange, all around the field of metrology.

This is why and how M4SET became the engine of an initiative oriented to improving air quality monitoring in Latin America.

A problem defined

Over the last couple of years, a group of Latin American organizations related to both metrology and air quality, considering air pollution as one of the most important environmental and public health problems in urban centers, identified the need to strengthening atmospheric monitoring systems that guarantee surveillance of the state of air quality and generate updated, accurate and reliable information that can be intercomparable not only over time but among different places, cities and even countries; a kind of information able to define, make, monitor and assess air quality monitoring systems and their contribution to the protection of humans and ecosystems and related policies and regulations.

The overall air quality monitoring problem stems from an insufficient involvement of the metrology community with the air quality monitoring activities and to overcome it, stakeholders determined the need to: i) train monitoring systems officials on issues related to uncertainty, traceability, metrological confirmation systems, among others, ii) design metrological confirmation systems that guarantee the reliability of the data generated by the air quality monitoring networks, iii) create technical and operational capacities for calibration of air analyzers, iv) create synergies and collaboration between regional organizations in charge of air quality monitoring.

Program initiatives

[22] It must be noted, however, that the Cost-benefit analysis of M4SET and M4EE included in section 3 and Annex C of this report, estimates the potential positive impacts in LAC for women of improved street lighting in more than $ 230m.

Responding to technical proposals initially crafted by Costa Rica, Uruguay, and Mexico, and later joined by Argentina and Mexico again, M4SET worked on the implementation of the following initiatives that also involved Brazil, Chile, Colombia, and Ecuador:

1. Regional Workshop: "Metrology Support for the Quality Assurance of measurements of Air Quality Monitoring Networks" June 5-7, 2018, San José Costa Rica.
2. Regional Workshop: "Strengthening Air Quality Monitoring in Latin America" August 26-29, 2019, Mexico City, Mexico
3. Creation of a hemispheric Air Quality Network Group to share information, experiences, concerns, best practices while promoting collaboration among countries
4. Webinar: "Analyzing the behavior of air pollutants during the Covid-19 global lockdown", April 16, 2020, for air quality monitoring station operators who were facing challenges in interpreting unusual data emission patterns, given dramatic drops in regional traffic and reduced industrial and commercial activity.
5. Inter-laboratory study for ozone calibration compatibility in Latin America, Aug-Nov 2020, aimed to compare calibration methods used in Latin America with those of NIST to improve ground-level ozone measurements

These initiatives comprised a variety of activities such as conferences, roundtables, theoretical training, visits, institutional presentations, hands-on experiences, studies, technical assistance, webinars, and both face-to-face and online networking with participation of dozens of individuals not only from the beneficiary countries, but also from U.S organizations and companies such as NIST, Battelle, Maryland Department of Environment, as well as independent consultants.

Program Outcomes

Improved Technical Skills

The most significant change M4SET brought to their stakeholders is the increased knowledge, expertise, abilities, and perspectives, not only theoretical, but also practical gained by individual members of the metrology community in Latin America. Participants in the program's activities consistently stated that their technical skills increased due to what they learned in presentations, technical discussions, and networking opportunities provided by the program and so they have acquired a broader and deeper knowledge of international practices on air quality monitoring and the role of metrology on it, which they have been able to apply in their jobs, not only on very technical aspects such as calibration, traceability, comparability, among others, but also in more operational matters such as protocols, documentations, data management, and quality assurance.

Improved innovation and institutional capacities

Program activities also contributed to innovation and improving institutional capacities in several agencies. Some examples:

- Colombia: The analysis and monitoring laboratory of Colombian National University in Medellin-CALAIRE now offers calibration services based on the norm ISO IEC 17025. It is the first laboratory in Colombia to get this certification. Thanks to the training received in 2018 from M4SET, CALAIRE implemented a new procedure to verify specifications of an equipment used for ozone measurement traceability. Likewise, the lab obtained accreditation from National Accreditation Organism in Colombia (ONAC). CALAIRE's representative attributes these successes in part to the procedures learned in the program and the contacts it provided.

- Argentina: After the training was completed, the National Institute of Industrial Technology INTI started to work on the traceability of air quality measurements.
- Guatemala was able to provide maintenance to air monitoring stations that were out of service.

Fostering International cooperation on air quality measurement

While the financial support of the US Government and NIST partnership with M4SET exemplify the success of North-South cooperation, the program has also nurtured cooperation among Latin American countries. Many program activities have been led by the countries themselves and supported by the M4SET team. Colombia, Argentina, and Mexico have shown outstanding leadership, not only taking advantage of the opportunities offered by the project, but also promoting the exchange of practices and regional cooperation to improve measurement capabilities among atmospheric monitoring networks in Latin America.

- Mexico: The National Institute of Ecology and Climate Change INECC, collaborated with Honduras to conduct an operative diagnosis of monitoring system and data traceability.
- Colombia: CALAIRE supported Guatemala in the estimation of uncertainties and calibration processes of gas, particles, and meteorological monitoring equipment.
- Brazil: The Environmental Company of the State of Sao Paulo, CETESB helped the Environmental Protection Agency of Buenos Aires to solve technical problems associated with the validation of methods used to measure fine particle matter. Brazil had undergone same technical issues years ago.
- Several countries joined forces to plead with a supplier that was no longer providing spare parts for a discontinued piece of equipment. The supplier agreed to provide the part for two more years considering the unified request from the countries.
- The Environmental Protection Agency of Buenos Aires and Mexico City Atmospheric Monitoring System SIMAT implemented a technical exchange to visit Mexico City and Queretaro to learn about the technology used in the monitoring systems of these two cities. This collaboration evolved in the submission of a joint proposal to implement a follow-up training focused on Quality Control.
- Creation of Air Quality Network Group to share information and best practices: This networking group is comprised of 40 experts. The group includes government staff from air quality monitoring networks in the Americas, as well as field experts that communicate frequently using Google groups and WhatsApp.

Laying foundations for policy making

In line with M4SET purpose that the technical work and increased capabilities translate into better policies for air quality, there are few cases were progress is being occurring, that is the case of Argentina, where there is an ongoing discussion for the update of permissible limits of criteria pollutants. Moreover, by promoting data comparison with provinces, air quality has started to become part of the agenda of local authorities. Likewise, in Ecuador, there is ongoing work to update the calculation method of the Air Quality Index of Quito and the Air Quality Norm of Ecuador.

Lessons Learned

Training a key component

Participants agree that M4SET activities achieved their intended objectives and outputs. They state the training received had increased their level of knowledge, contributed to application in their jobs and responsibilities and, in some cases improved their organizations performance.

However, it is not the training understood as mere presentations or conferences, it is the event as a whole, including hands-on experiences, visits, discussions, networking, and the shaping of a sense of community. Some interviewees went more specific to describe the benefits of training by praising the program for their acquired “troubleshooting” abilities.

Adaptive project implementation and management

Permanent consultation, persistent assessment of training under Kirkpatrick model, active involvement of stakeholders in activities’ design, relentless follow up and the strong partnership between OAS and NIST were essential to managing and implementing a project in a flexible and adaptive fashion that not only met the needs and expectations of the target beneficiaries, but considered changing circumstances including a pandemic.

Sustainable actions

M4SET has created a sense of collaboration that is expected to endure beyond its conclusion. Cooperation among air quality monitoring stations in the region is likely to continue, given that there is already a solid channel of communication among stakeholders and shared interests among them. Some countries are already taking the leadership to continue working towards improving the quality of air quality measurements having in mind a regional perspective and the importance of metrology as a tool for air quality protection.

Challenges remain

Some of the areas that continue to be a challenge for the air quality monitoring stations of the region are the lack of equipment, the acquisitions of calibration standards, and the inter-comparison among stations. MS4SET participants, believe that future areas of opportunity could consist in supporting the implementation of special assessments for air quality stations with fewer capabilities, joint purchases of equipment and standards to reduce costs, bilateral cooperation and technical exchanges, sustained information sharing, as well as continued hands-on training and policy-makers awareness.

10. Findings, conclusions, recommendations

Findings

- The extent to which the projects activities and design did respond to specific needs, policies or priorities was evidenced at several levels. Stakeholders considered M4SET and M4EE highly relevant.

- M4SET and M4EE clearly achieved their results (outputs, outcomes, purpose, and goals). Not merely they met their performance indicators, but they achieved many tangible personal, institutional, and technological transformations.

- The ToC of the projects is mostly valid and confirms causality between project’s actions and their results, in both the short and the long term.

- Documents, data, and testimonials, as well as theoretical considerations assert the projects’ attribution, in other words that there is a causal link between projects’ initiatives and demonstrable effects whether they are in terms of individuals’ technical skills, institutions’ new capabilities or relationships, or changes in the policy environment.

- A key element in securing attribution, as well as project's effectiveness, was the application of results-based management principles, practices, and procedures from projects' design to closing.

- Both projects achieved a considerable economic and social return of investment as determined by its CBA

- Applying RBM, along with a systematic monitoring of projects' stakeholders, activities and results allowed the project implementation team, together with other stakeholders, to be aware of changing circumstances, learn the corresponding lessons and be able to adapt activities accordingly.

- M4SET and M4EE made an efficient utilization of time, staff, and partnerships. Efficiency in assignation of budget is an institutional matter that falls beyond the scope of this evaluation.

- Although the immediate financial sustainability of projects' activities is null due to the lack of funding, the economic, technological, political, and environmental sustainability of the activities carried out by the projects is significant.

- Although recognized as an essential element of any project for development, the gender perspective in the projects and in metrology in general, remains a challenge both conceptually and programmatically.

- MA4SET and M4EE did find unforeseeable/not planned results or outcomes, such as the active networking, collaboration, and mutual technical support among individuals who participated in projects' activities, or the challenges, solutions and potential of remote technical cooperation imposed by the COVID-19 pandemic.

Conclusions

- MASET and M4EE demonstrated the great potential of the south-south cooperation for development, whenever it aims to solve problems of regional interest, through projects well-conceived and managed.

- Although the INMs may be isolated from decision-making and other technological institutions in their countries, they are receptive to initiatives that could enhance their contribution to national and international objectives towards the adoption of sustainable energy and air quality technologies aimed to foster a low carbon economic growth in the Americas.

- The formation and maintenance of adequate technical and policy-making contacts/partners, people, and institutions, in the countries is essential for effective project implementation.

- As successfully learned from M4EE and its positive relation with SICA, whenever a project aims to public policy-making, besides being well designed and implemented a technology-related project needs to be furnished with lobbying capabilities that allows it to "speak-policy' in an effective way.

- The success of OAS in implementing M4SET and M4EE is, however, dependent of money, knowledge, as well as technical and management staff, the organization normally lacks. This made the OAS-NIST partnership a powerful and synergic alliance highly valued by people, institutions, and countries.

- Despite scarce resources, the projects demonstrated the power of motivated individuals practicing networking and thereby contributing to achieving common goals.

- The projects raised the visibility of metrology in LAC and strengthened the Interamerican Metrology System - SIM

Recommendations to OAS

- Make sure to retain within the organization the knowledge, experience, and skills acquired by the implementation team through the projects' lifecycle. This human capital will be valuable to design and execute similar initiatives in the future.

- Document the experience so that best practices, lessons learned, results, as well as difficulties and setbacks experienced by the projects from design to completion, are systematically recorded.

- Share success with other OAS areas. With a properly documented experience will be possible for other areas of the OAS, particularly those involved in project implementation, to learn an accumulate institutional knowledge.

- Within the framework of ECPA, keep the momentum achieved by the projects by keeping in touch with stakeholders and their networks. By playing "I know who know what you don't know", sharing low cost information, and being active with those OAS-DSD might be able to contribute to the sustainability of the projects.

- Divulge experiences, lessons, and success throughout the region stakeholders both in the metrology, energy quality, energy efficiency and air quality communities, and the policy-making actors not only of those countries that participates in M4SET and M4EE but throughout the whole LAC.

Annex A. Terms of Reference

GENERAL SECRETARIAT OF THE ORGANIZATION OF AMERICAN STATES
Strategic Counsel for Organizational Development and Management for Results
DEPARTMENT OF PLANNING AND EVALUATION

Call for Resumes:

External Evaluation of the Projects: "Advancing Metrology for Energy Efficient Measurements and Compliance in Central America and Dominican Republic" and "Advancing Metrology for Sustainable Energy Technologies and the Environment in the Western Hemisphere - Second Phase"

Type of Appointment: Individual consultancy
Organizational Unit: Department of Planning and Evaluation
Duration: approximately 4 months (40 non-consecutive days, see paragraph 5.1).
Consulting Fee: based on experience, education and skills
Duty Station: Washington DC, Member Countries and consultant's place of residence

Profile: The consultant must demonstrate a minimum of 10 years of experience in project evaluation and must hold a graduate degree in public policy, economics, evaluation, social sciences and management or related area; and have experience working in Latin America and the Caribbean. In addition, the consultant should be proficient in the use of the English language, oral and written. Experience in the Sustainable Energy sector, in working with an international organization in the Americas, and in the evaluation of similar projects are not a requirement but will be a plus.

I. Introduction

A. Background

1.1 At the request of the US Permanent Mission to the OAS, the Department of Planning and Evaluation (DPE) is coordinating an external assessment of Projects "Advancing Metrology for Energy Efficient Measurements and Compliance in Central America and Dominican Republic" and "Advancing Metrology for Sustainable Energy Technologies and the Environment in the Western Hemisphere - Second Phase". This assessment is part of the DPE's greater efforts to conduct formative and summative evaluations of projects and programs executed by the OAS. Such efforts, coordinated and supervised by the DPE, began over 10 years ago with the evaluation of initiatives financed by the Spanish Fund for OAS and has been extended to operations financed by other donors, such as Canada and the United States of America. These evaluations, in addition to systematizing and documenting the results of the interventions, have the goal of capitalizing on these experiences for the improvement of future project and program formulations and designs, and institutionalizing best practices in monitoring and evaluation within the Organization. Both projects are currently being coordinated by the OAS Department of Sustainable Development/Secretaría Ejecutiva de Desarrollo Integral (DSD/SEDI/OAS).

1.2 The field of Metrology is not new for the OAS which has supported this area of knowledge since 1979, when the Inter American Metrology System (SIM) was created as part of the special project on metrology, led by the former Department of Scientific and Technological Affairs. Metrology as science of measurements has various applications that have implications at the economic and social level. Measurements cannot be produced without the existence of units, standards and measurements instruments. Metrology is especially important to support ongoing changes in the fields of industrial processes and applications such as health and environment. Metrology is used to measuring operations that are vitally important in the public health such as the reliability of measurements instruments in intensive care units. Measurements allow industries to be innovative and competitive by giving them the ability to know if a product meets consumer and user requirements. Similarly, the protection of the environment implies statutory requirements on nuisances and the quality of air and water, and all this involves measurements, therefore Metrology.

B. Metrology Projects from 2016 to 2020

Advancing Metrology for Sustainable Energy Technologies and the Environment in the Western Hemisphere - Second Phase – SID1606

1.3 Since 2013, the Department of Sustainable Development (DSD) of the OAS has been supporting metrology efforts in the Americas, focalizing the support towards aspects of Climate Science and Sustainable Energy. Phase I, "Renewable Energy and Climate Science: Metrology and Technology Challenges in the Americas (RECS-SID 1306)" sought to invigorate the role of metrology by supporting the use of international standards and measurements as a means to address the challenges associated with policy making for climate science and sustainable energy technology. The first phase of this project (SID 1306) had as a major output the implementation of the "Regional Strategy and Outreach Plan for Renewable Energy and Climate Science: Metrology and Technology Challenges faced by countries of the Americas", which encompassed the execution of regional workshops and hands-on individual technical trainings. These activities were implemented in each metrology region: i) CAMET– Central America, ii) SURAMET- Southern Cone, iii) ANDIMET – Andean Region, and iv) CARIMET – Caribbean. Annex I describes the findings of these activities. This initiative was implemented in partnership with the U.S. National Institute of Standards and Technology (NIST) and concluded in July 2016.

1.4 Phase II (SID1606) focused on the environmental aspect of this science, as well as the support towards measurement aspects associated with sustainable energy, natural resources monitoring and clean air. The problem that the project sought to address was the limited technical and technological capabilities of several countries in the region on measurements associated to alternative energy, energy efficiency and air quality. Effective policy-making and enforcement requires coordination between regulators and technical agencies. To enforce this important aspect of connection between the technical and the political, the project requested the designation of one technical and one political focal point in each country. Directors of the national metrology institutes (technical focal points) and political focal points, via the project planning committee, were invited to plan the instances of technical training to be delivered, and were responsible for defining their content, based on their countries' priorities and needs. They engaged with key stakeholders in each country, to gather the trainings needs as well as to follow up after the technical trainings and project activities are implemented.

1.5 The Metrology for Sustainable Energy Technologies and the Environment (M4SET) aimed at strengthening metrology capabilities in the fields of sustainable energy and environment through training and awareness of relevant high-ranking government officials and technical stakeholders in ministries of energy, environment, national metrology institutes, normalization and accreditation bodies, and academia. The project contributed to a greater involvement and technical support of the metrology community on aspects associated to GHG emission measurements, air quality, natural resources monitoring, energy efficiency, and renewable energy.

Advancing Metrology for Energy Efficient Measurements and Compliance in Central America and Dominican Republic (M4EE) - SID1605

1.6 The findings of RECS showed that Central America and Dominican Republic would derive major benefits from improving the quality of their energy efficiency measurement methods and infrastructure. From the perspective of science and technology, these countries still have some technical limitations in measuring aspects for conformity assessment, energy efficiency standards and labeling programs for equipment and appliances, and adequate testing facilities. At the political level, most SICA Member States have legal frameworks that address issues related to energy efficiency. However, despite such laws to promote energy efficiency, lack of adequate measurement and infrastructure standards make it difficult to apply these laws and regulations. While RECS was a good first step in that direction, further actions must be undertaken for governments to address metrology challenges and improve energy efficiency capabilities and services.

1.7 The purpose of the project was to strengthen measurement capabilities and knowledge of government officials and technical stakeholders in the field of energy efficiency in Central America and Dominican Republic. Additionally, the OAS and the U.S. National Institute of Standards and Technology (NIST) promoted the participation of development banks and other similar organizations. The project addressed this issue and the need of countries to invest on technology infrastructure. Likewise, due the lack of standards laboratories in the region, OAS and NIST built a closer relation with countries that have a good infrastructure

1.8 The M4EE offered support through awareness, raising actions and the facilitation of knowledge sharing, best practices, technical training and exchanges that increase metrology and conformity assessment's skills of high ranking government officials and technical stakeholders engaged in the implementation and enforcement of national policies, laws and regulations on energy efficiency in Central America and Dominican Republic.

1.9 The support provided by OAS and NIST through this project sought to strengthen measurement capabilities of government officials and technical stakeholders to perform energy efficiency measurement and compliance assessments in equipment and appliances at the national or regional level.

1.10 Both projects, SID1605 and SID1606, were financed by the United States Department of State, through the U.S. Permanent Mission to the OAS in the amount of US$ 795,678, with an OAS in-kind contribution of US$ 150,142.40, and US$ 776,275.86, with an OAS in-kind contribution of US$ 150,142.40, respectively.

II. Objective

1.11 The objective of the Consultancy is to evaluate the efficiency, effectiveness, and sustainability of both Metrology Projects. The evaluation will specifically focus on the delivery of the main Outputs, and the Immediate and Intermediate Outcomes for the projects. To achieve the objective, the Consultant shall:

I. Conduct a formative and summative evaluation in order to assess the projects' progress in achieving its objectives.
II. Determine, to the extent possible, the effectiveness of the project as best reflected in the available results to date.
III. Critically analyze the formulation, design, implementation and management of the projects and make recommendations as needed.
IV. Conduct a cost benefit analysis by determining the internal rate of return and net present value of the investment.
V. Assess the likelihood of institutional and financial sustainability of the interventions financed by the projects.
VI. Document lessons learned related to the formulation, design, implementation, management, and sustainability.
VII. Make recommendations, as appropriate, to improve the formulation, design and implementation for future similar interventions.
VIII. Assess if and how the projects addressed the crosscutting issue of gender perspective and to what results.

2.2 In addition to the above, the consultancy will make every attempt to answer the following performance questions:

I. Were the output and outcome indicators achieved? If not, explain why.
II. Were the results achieved attributable to the actions of the operation?
III. If empirical attribution cannot be stablished, is there a robust theoretical attribution?
IV. Did the projects team apply results-based management principles from its inception to its conclusion?
V. Were lessons learnt identified during the implementation of the projects?
VI. Was the monitoring mechanism used as an efficient and effective tool to follow-up on the progress of projects' actions?
VII. Were there any unforeseeable/not planned results or outcomes?

A. Information sources.

Among other sources, the consultant will review the following:

- Project documents.
- Progress implementation reports.
- Completion report of phase II.
- Project indicators identified in the logical frameworks.
- Products derived from the implementation of the projects and means of verification.
- Any other document deemed relevant for the completion of the work.

B. Stakeholders.

Among other stakeholders, the consultant will consider the following:

- Project Team.
- Member states.
- Local and national counterparts.
- Donors.
- U.S. State Department.
- Beneficiaries.

III. Activities

3.1 This consultancy will be coordinated and supervised by the OAS Department of Planning and Evaluation (DPE).

3.2 The consultant shall work in close cooperation with SEDI/DSD, which shall designate a member of their staff to facilitate the evaluation process. The evaluation process will take a participatory approach and take account of the views of all key stakeholders. In general, the evaluation will be based on interviews, analysis of documents,

hard data, use of relevant evaluation instruments and all available data sources, as required. In addition, the consultant shall:

3.3 Develop a brief work plan and evaluation framework for the consultancy, including the description of the activities to be performed and the products as well as the order and focus of each.

3.4 Review key documents in the execution of the projects, among them: the project proposals, logical frameworks used for the design and implementation of the projects, indicators, and results achieved to date; progress and final reports on the execution of the projects to date, and financial documents, among others.

3.5 Conduct interviews and collect information from key stakeholders, including: Project Team; U.S. Mission's officials; government officials, and direct and indirect beneficiaries, among others.

3.6 Conduct interviews to assess the performance of both operations, their outcomes and outputs.

3.7 Identify lessons learned, best practices and recommendations for the ongoing and future executions.

3.8 Conduct a robust cost-benefit analysis of the operation (CBA), by: identifying and quantifying the social and economic costs and benefits of the program; collecting the necessary data to validate the CBA proposal; conducting a literature review to support theoretically the social and economic costs and benefits and monetize them; estimating the returns to the investment by calculating the Net Present Value (NPV), and the Internal Rate of return at 12%.

3.9 Produce a Mid-term report describing the progress of the evaluation and the findings to date. The report will be accompanied by a Power Point presentation. Participate in a videoconference with OAS headquarters to present the report.

3.10 Produce a final report analyzing and describing the execution of the supported actions; the results of the CBA; lessons learned, recommendations and conclusions; a section for sustainability and beneficiaries, among others. The report will be accompanied by a Power Point presentation.

3.11 The evaluator shall follow at any moment during the evaluation process, the OAS Code of Ethics and the UNEG Norms and Standards for Evaluation.

IV. Products and Deliverables

4.1 The consultancy will produce and deliver the following documents taking into consideration each of the activities described in the above section:

i) A detailed work plan and the evaluation Framework within 15 days of signing the contract.

ii) A draft Mid-term Report on the progress of the consultancy including the identification and quantification of social and economic costs and benefits and a Power Point to be presented on a previously agreed date. When?

iii) Final Evaluation Report including all products mentioned above and a Power Point Presentation to be presented at OAS headquarters on a previously agreed date. When?

Annex B. Evaluation Design

Evaluation of the Projects:

"Advancing Metrology for Energy Efficient Measurements and Compliance in Central America and Dominican Republic" (M4EE)

And

"Advancing Metrology for Sustainable Energy Technologies and the Environment in the Western Hemisphere - Second Phase" (M4SET)

INCEPTION REPORT

Luis Bernal MPP
September 10th, 2020


National Institute of
Standards and Technology
U.S. Department of Commerce


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para más gente


metrología para las
TECNOLOGÍAS ENERGÉTICAS
SOSTENIBLES Y EL MEDIO AMBIENTE


METROLOGÍA PARA TECNOLOGÍAS
ENERGÉTICAMENTE EFICIENTES

Acronyms

ANDIMET	Andean Metrology Institutions
CAMET	Central America Metrology Institutions
CARIMET	Caribbean Metrology Institutions
CBA	Cost Benefit Analysis
DR	Document Review
EE	Energy Efficiency
EQ	Evaluation Question
ET	Evaluation Team
GHG	Green House Gases
KII	Key Informant Interview
LAC	Latin-America and the Caribbean
M4EE	Metrology for Energy Efficiency CA+DR
M4SET	Metrology for Sustainable Energy Technologies and the Environment (Hemispheric)
NIST	U.S. National Institute of Standards and Technology
NMI	National Metrology Institutions
OAS	Organization of American States
OAS - DPE	Organization of American States - Department of Planning and Evaluation
OAS - DSD	Organization of American States - Department of Sustainable Development
OAS - GS	Organization of American States - General Secretariat
OAS - SEDI	Organization of American States - Executive Secretariat for Integral Development
OS	Online Survey
RECS	Renewable Energy and Climate Science
RTCA	Central American Technical Regulations
SICA	Central America Integration System
SID 1605	Metrology for Energy Efficiency CA+DR (This project)
SID 1606	Metrology for Sustainable Energy Technologies and the Environment (Hemispheric)
SIM	Inter-American Metrology System
SURAMET	Southern Cone Metrology Institutions
SWOT	Strengths, Weaknesses, Opportunities, Threats Analysis
ToC	Theory of Change
ToR	Terms of Reference

"Advancing Metrology for Energy Efficient Measurements and Compliance in Central America and Dominican Republic" (M4EE)
And
"Advancing Metrology for Sustainable Energy Technologies and the Environment in the Western Hemisphere - Second Phase" (M4SET)
EVALUATION INCEPTION REPORT

1. Introduction and Evaluation Purpose

At the request of the US Permanent Mission to the Organization of American States (OAS), its Department of Planning and Evaluation (DPE) is coordinating an external assessment of Projects "Advancing Metrology for Energy Efficient Measurements and Compliance in Central America and Dominican Republic" and "Advancing Metrology for Sustainable Energy Technologies and the Environment in the Western Hemisphere - Second Phase".

The purpose of the external evaluation is to determine and assess the efficiency, effectiveness, and sustainability of both metrology projects, by analyzing the delivery of the main outputs, and the immediate and intermediate outcomes for the projects. Likewise, as per its Terms of Reference (ToR), the evaluation is expected to document lessons to be learned and make recommendations regarding projects' formulation, design, implementation, management, and sustainability. Finally, the evaluation must determine whether the projects addressed the "gender perspective" and to what results.

Luis Bernal, MPP is in charge of the evaluation, as an individual contractor, he is solely responsible before the OAS for the quality of the evaluation; however, he has resorted to the extensive expertise of Dr. Ulrike Hotopp to lead the Cost Benefit Analysis (CBA) of the projects requested by the ToR, and therefore the two constitute the Evaluation Team (ET) for such purpose.

2. Projects' Background and Description

Since 2013, the Department of Sustainable Development (DSD) of the OAS has been supporting metrology efforts in the Americas, focalizing the support towards aspects of Climate Science and Sustainable Energy. The project "Renewable Energy and Climate Science: Metrology and Technology Challenges in the Americas (RECS-SID 1306)" sought to invigorate the role of metrology by supporting the use of international standards and measurements as a means to address the challenges associated with policy making for climate science and sustainable energy technology. The major output of the initiative was the implementation of the "Regional Strategy and Outreach Plan for Renewable Energy and Climate Science: Metrology and Technology Challenges faced by countries of the Americas", which encompassed the execution of regional workshops and hands-on individual technical trainings. These activities were implemented in each metrology region: i) CAMET– Central America, ii) SURAMET- Southern Cone, iii) ANDIMET – Andean Region, and iv) CARIMET – Caribbean. This initiative was implemented in partnership with the U.S. National Institute of Standards and Technology (NIST) and concluded in July 2016 and was the origin of the two projects being evaluated, which are described below.

Advancing Metrology for Sustainable Energy Technologies and the Environment in the Western Hemisphere - Second Phase – SID1606, also known as M4SET. Focused on the environmental aspect of this science, as well as the support towards measurement aspects associated with sustainable energy, natural resources monitoring and clean air. The problem that the project sought to address was the limited technical and technological capabilities of several countries in

the region on measurements associated to alternative energy, energy efficiency and air quality. Effective policymaking and enforcement require coordination between regulators and technical agencies. To enforce this important aspect of connection between the technical and the political, the project requested the designation of one technical and one political focal point in each country. Directors of the national metrology institutes (technical focal points) and political focal points, via the project planning committee, were invited to plan the instances of technical training to be delivered, and were responsible for defining their content, based on their countries' priorities and needs. They engaged with key stakeholders in each country, to gather the training needs as well as to follow up after the technical trainings and project activities are implemented.

M4SET aimed at strengthening metrology capabilities in the fields of sustainable energy and environment through training and awareness of relevant high-ranking government officials and technical stakeholders in ministries of energy, environment, national metrology institutes, normalization and accreditation bodies, and academia. The project contributed to a greater involvement and technical support of the metrology community on aspects associated with GHG emission measurements, air quality, natural resources monitoring, energy efficiency, and renewable energy.

The following are the essentials of M4SET:

Name: Advancing Metrology for Sustainable Energy Technologies and the Environment in the Western Hemisphere – Second Phase SID1606 (a.k.a. M4SET)

Prodoc date: 4/24/2017. Estimated Duration: 48 months. Estimated Start Date: 11/9/2016

Beneficiary Countries: Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panana, Paraguay, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay, Venezuela.

Beneficiary Individuals: high-ranking government officials and experts engaged in climate change, renewable energy and energy efficiency policy making, regulation and enforcement: i) Ministries of Energy, Environment and Commerce, ii) NMIs, iii) Accreditation and Normalization Bodies, iv) Universities and other institutions related to climate change and sustainable energy.

GOAL: To support the deployment of sustainable energy technologies and foster low carbon economic growth in the Americas.

Purpose: To strengthen the technical and technological capabilities of the metrology community, government officials and other technical stakeholders in the fields of energy efficiency, renewable energy, air quality and greenhouse gases in beneficiary countries

Results at the level of Outputs

Output 1: High-ranking officials mindful of the value of metrology applications for advancing greenhouse gas emissions reduction, air quality monitoring and improving measurement infrastructure for sustainable energy development in the Americas.

Activity 1.1 Identify institutions conducting initiatives on air quality, renewable energy and energy efficiency in the Americas and establish strategic alliances to further energy sector transformation

Activity 1.2: Organize three high level public fora with strategic partners to raise awareness among government officials regarding the value of metrology as a means to support renewable energy, energy efficiency and air quality.

Output 2: Government officials from ministries of energy, environment, energy, commerce, national metrology institutes, accreditation and normalization bodies and academia increased knowledge in measurement sciences applied to air quality, greenhouse gas emissions, and renewable and efficient energy standards.

Activity 2.1: Organize at least five long-term (up to six months) technical exchanges on measurement and technical testing capabilities associated with air quality, GHG measurement, energy efficiency and renewable energy for national metrology institute officials.

Activity 2.2: Organize three one-week technical exchanges on energy efficiency and climate science policy and regulation with private and public sector institutions.

Activity 2.3: Organize at least two government expert trainings on measurement standards for renewable energy and energy efficiency to support air quality assessment and greenhouse gas monitoring.
Activity 2.4: Selection process of the requests for technical cooperation from beneficiary countries.

Output 3: Project planning, monitoring, administration, and evaluation.
Activity 3.1: Development of project profile and/or project document and monitoring plan.
Activity 3.2: Management and supervision of the project
Activity 3.3: Development, collection, and analysis of pre and post knowledge or follow-up questionnaires for participants in the capacity building activities of the project
Activity 3.4: Collection data and information for monitoring reports
Activity 3.5: Compilation, analysis, and validation of final reports.
Activity 3.6: Prepare semiannual progress reports and final report
Activity 3.7: Define terms of reference in collaboration with the Department of Planning and Evaluation for external evaluator
Activity 3.8: Coordination and execution of External evaluation of the results of project
Activity 3.9: Disseminate project results

Responsible and Other Participating Departments (OAS): Department of Sustainable Development (DSD)
Executing Institution: Organization of American States- Department of Sustainable Development
Counterpart Agencies:

8. PMUREE
9. Inter-American Metrology System (SIM) - CAMET Region (Central America)
10. National Ministries Involved
11. ECPA Focal Points

Total Estimated Budget (US $) by Source of Financing

Source	Contribution	ICR	Cont.	Available	%
NIST	125,000.00	0.00 %	0.00 %	125,000.00	11.44 %
Beneficiary Countries In-Kind	125,250.00	0.00 %	0.00 %	125,250.00	11.46 %
GS/OAS	150,142.40	0.00 %	0.00 %	150,142.40	13.74 %
US/OAS	795,678.16	13.00 %	0.00 %	692,240.00	63.36 %
Total:	1,196,070.56			1,092,632.40	

Advancing Metrology for Energy Efficient Measurements and Compliance in Central America and Dominican Republic (M4EE) - SID1605. The findings of RECS showed that Central America and Dominican Republic would derive major benefits from improving the quality of their energy efficiency measurement methods and infrastructure. From the perspective of science and technology, these countries still have some technical limitations in measuring aspects for conformity assessment, energy efficiency standards and labeling programs for equipment and appliances, and adequate testing facilities. Although most members of the Central American Integration System (SICA) have legal frameworks that address issues related to energy efficiency however, their lack of adequate measurement and infrastructure standards make it difficult to apply these laws and regulations. While RECS was a good first step in that direction, further actions must be undertaken for governments to address metrology challenges and improve energy efficiency capabilities and services.

The purpose of the project is to strengthen measurement capabilities and knowledge of government officials and technical stakeholders in the field of energy efficiency in Central America and Dominican Republic. Additionally, the OAS and the U.S. National Institute of Standards and Technology (NIST) aim to promote the participation of development banks and other similar organizations as the project sought to address the need of countries to invest on technology infrastructure. Likewise, due the lack of standards laboratories in the region, OAS and NIST have built a closer relation with countries that have a good infrastructure
The M4EE aimed to offer support through awareness-raising actions and the facilitation of knowledge-sharing, best practices, technical training and exchanges that increase metrology and conformity assessment's skills of high ranking government officials and technical stakeholders

engaged in the implementation and enforcement of national policies, laws and regulations on energy efficiency in Central America and the Dominican Republic.
The support provided by OAS and NIST through this project sought to strengthen measurement capabilities of government officials and technical stakeholders to perform energy efficiency measurement and compliance assessments in equipment and appliances at the national or regional level.
The following are the essentials of M4EE:

Name: Advancing Metrology for Energy Efficient Measurements and Compliance in Central America and Dominican Republic SID1605 (AKA M4EE)

Prodoc date: 6/7/2017. Estimated Duration: 48 months. Estimated Start Date: 11/9/2016

Beneficiary Countries: Belize, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, Panama

GOAL: To contribute to a sustainable energy policy development in Central America and Dominican Republic

Purpose: To strengthen measurement capabilities and knowledge of government officials and technical stakeholders in the field of energy efficiency in Central America and Dominican Republic.

Results at the level of Outputs
Output 1: High-ranking officials in Central America and Dominican Republic mindful of the value of metrology to address energy efficiency policymaking for household air conditioners, refrigerators, lamps and electric motors.

Activity 1.1: Identify institutions conducting energy efficiency initiatives and programs and establish strategic alliances to further energy efficiency
Activity 1.2: Organize two high-level public fora with strategic partners to raise awareness among government officials regarding the value of metrology as a means to support energy efficiency.

Output 2: Technical experts from ministries of energy, environment, energy, commerce, national metrology institutes, accreditation and normalization bodies and academia in Central America and Dominican Republic increased knowledge in energy efficiency performance and measurement standards and testing protocols for equipment and appliances.

Activity 2.1: Organize one meeting with government experts to discuss the implementation of the Central American Regional Technical Regulation on energy efficiency for appliances and equipment.
Activity 2.2: Organize at least two technical trainings for government experts on technical aspects associated with energy performance standards and testing and enforcement protocols for the implementation of the Central American Technical Regulation on energy efficiency for equipment and appliances.
Activity 2.3: Organized at least four webinars on energy efficiency measurements and compliance
Activity 2.4: Organize at least three technical exchanges on energy efficiency for national metrology institutes or technical agencies involved in the design and implementation of the RTCA.
Activity 2.5: Coordinate the delivery of technical advice according to requests from beneficiary countries.
Activity 2.6: Selection process of the requests for technical cooperation (technical training, exchanges and advise) from beneficiary countries.

Output 3: Project planning, monitoring and evaluation.

Activity 3.1: Development of project profile and/or project document and monitoring plan.
Activity 3.2: Management and supervision of the project
Activity 3.4: Collection data and information for monitoring reports
Activity 3.5: Compilation, analysis, and validation of final reports
Activity 3.6: Prepare semiannual progress reports and final report.
Activity 3.7: Define terms of reference in collaboration with the Department of Planning and Evaluation for external evaluator
Activity 3.8: Coordination and execution of External evaluation of the results of project
Activity 3.9: Disseminate project results

Responsible and Other Participating Departments (OAS): Department of Sustainable Development (DSD)
Executing Institution: Organization of American States- Department of Sustainable Development
Partner Agencies:

1. Inter-American Metrology System (SIM) - CAMET Region (Central America)
9. Belize Bureau of Standards

10. Laboratorio Costarricense de Metrología (LACOMET)
11. Centro de Investigaciones de Metrología – El Salvador
12. Centro Nacional de Metrología – Guatemala
13. Centro Hondureño de Metrología
14. Laboratorio Nacional de Metrología (LANAMET)- Nicaragua
15. Centro Nacional de Metrología Panamá
16. Instituto Dominicano para la Calidad

2. Central America Integration System (SICA)
3. Designated National Ministries

Total Estimated Budget (US $) by Source of Financing

Source	Contribution	ICR	Cont.	Available	%
Beneficiary Countries In-Kind	67,400.00	0.00 %	0.00 %	67,400.00	6.62 %
NIST	125,000.00	0.00 %	0.00 %	125,000.00	12.28 %
GS/OAS	150,142.40	0.00 %	0.00 %	150,142.40	14.75 %
US/OAS	776,275.86	13.00 %	0.00 %	675,360.00	66.35 %
Total:	1,118,818.26			1,017,902.40	

Since both M4SET and M4EE are close to come to end, their donors and the OAS are interested in having the projects evaluated so that some lessons can gathered from the experience and recommendations are made for future project formulation, design, management, implementation and sustainability. The following section addresses the design and methodology of the evaluation being proposed.

3. Evaluation Design and Methodology

3.1. Evaluation Approach

This evaluation will take a Theory-Based approach to evaluation[23], by which it will examine the Theory of Change (ToC) that the program assumed (or should have assumed) in its design and how it was expected to produce its results. The evaluation, therefore, will enquire whether such theory existed at project design and inception, or has been somehow implicitly in place and then will revisit it to explain how the program should have been expected to bring about the desired results. The evaluation will analyze the projects' logical frameworks to revisit their Theory of Change and assumptions which makes a foundation to determine the effectiveness of the projects, as well as their cost-benefit results.

This approach, is complemented by a participatory process involving program stakeholders in planning, executing, delivering and dissemination of the evaluation findings and recommendations.

As training is one of the largest components of both programs, and DSD used the Kirkpatrick model of Training Evaluation[24], this evaluation will enquire how it was utilized, with what results, and how it led to decisions for program improvement. Such enquire will be reflected in both the design of data collection methods and data analysis. Clearly, evaluating the learning of programs' trainees is far out of the scope of this evaluation, however, among the four levels of the Kirkpatrick method, "Level 4: Results" concurs with and will support this evaluation conclusions.

[23] https://www.canada.ca/en/treasury-board-secretariat/services/audit-evaluation/centre-excellence-evaluation/theory-based-approaches-evaluation-concepts-practices.html#toc4
[24] Kirkpatrick's Four Levels of Training Evaluation. James S and Wendy Kayser Kirkpatrick. ATD Press, 2016.

This evaluation will be non-experimental and largely qualitative in nature, but mixed methods will be used as appropriate. To answer the evaluation questions, data that is disaggregated and analyzed by sex will be used whenever such data are available.

Within the mixed-methods approach, the evaluation will include a strong component of Cost-Benefit Analysis (CBA) intended to identify and quantify the social and economic costs and benefits of the projects. More on CBA later in this report.

The ET will use its background on gender equality to ensure that a gender lens is applied to all data collection methods and the evaluation overall.

Overall, data analysis, as well as conclusions and recommendations will be based on evidence stemmed from the various data collection methods, which include Document and literature (DR) an Online Survey (OS), and Key Informant Interviews (KII) all online. Such analysis will not include any evaluator's opinions o perspectives.

Likewise, the ET will thoroughly follow during the evaluation process, the OAS Code of Ethics, and the UNEG Norms and Standards for Evaluation. Also, it will abide to the professional standards of the American Evaluation Association (AEA).

3.2. Evaluation Criteria and Questions

This evaluation will focus on answering the following evaluation questions (EQs) that OAS has posited:

8. Were the output and outcome indicators achieved? If not, explain why.
9. Were the results achieved attributable to the actions of the operation?
10. If empirical attribution cannot be stablished, is there a robust theoretical attribution?
11. Did the project's team apply results-based management principles from its inception to its conclusion?
12. Were lessons learnt identified during the implementation of the projects?
13. Was the monitoring mechanism used as an efficient and effective tool to follow-up on the progress of projects' actions?
14. Were there any unforeseeable/not planned results or outcomes?

To answer the EQs, the ET will:

9. Conduct a formative and summative evaluation to assess the projects' progress in achieving its objectives.
10. Determine, to the extent possible, the effectiveness of the project as best reflected in the available results to date.
11. Critically analyze the formulation, design, implementation, and management of the projects and make recommendations as needed.
12. Conduct a cost benefit analysis by determining the internal rate of return and net present value of the investment.
13. Assess the likelihood of institutional and financial sustainability of the interventions financed by the projects.
14. Document lessons learned related to the formulation, design, implementation, management, and sustainability.

15. Make recommendations, as appropriate, to improve the formulation, design, and implementation for future similar interventions.
16. Assess if and how the projects addressed the crosscutting issue of gender perspective and to what results.

Answers to the EQs will be given within the framework of the following evaluation criteria:

1. Relevance
2. Attribution
3. Effectiveness
4. Efficiency
5. Sustainability
6. Gender Mainstreaming

It must be noticed that the ToR did not include Relevance explicitly as an evaluation criterion to be considered, however, the ET is proposing to consider it given that it seems to be highly valued by OAS, their member states, and all stakeholders in general, as described by the two projects documents (prodocs). In turn, Attribution is a criterion stemmed from two of the Evaluation Questions.

3.3. Evaluation Methodology

This evaluation is conducted, in completely remote fashion, from Naples, FL hometown of the evaluator, between August 20th and November 6th, 2020. The period includes three weeks for planning, initial consultations and preliminary data collection, mostly for document review; four weeks for Key Informant Interviews (KII) and survey deployment and then five weeks for data analysis and writing the intermediate and the final report, including their respective presentations before the OAS staff, according to the following timeline

Table 4. Evaluation Timeline

WEEK (2020)	Mon	Tue	Wed	Thu	Fri
Aug 17-21				Aug 20 Contract Perfected	Data Collection
Aug 24-28	Data Collection (Document Review)				
Aug 31-Sep 4	Data Collection (Document Review)				
Sept 7 - 11	Data Collection (Document Review)			Sept 10 Inception Report Due	Data Collection
Sept 14-18	Data Collection (KII, OS, DR)				
Sept 21-25	Data Collection (KII, OS, DR)				
Sept 21-Oct 2	Data Collection (KII, OS, DR)				
Oct 5-Oct 9	Data Analysis / Mid – Term Report Drafting				
Oct 12-Oct 16	Data Analysis / Mid – Term Report Drafting				Oct 16 Mid-term Report Due
Oct 19-Oct 23	Feedback / Corrections				
Oct 26 – Oct 30	Feedback / Corrections/ Final Report Writing				
Nov 2 – Nov 6	Final Report Writing				Nov 6 Final Report Due

This section of the Inception Report addresses each phase of the evaluation: i) planning, ii) data collection, iii) data analysis and iv) dissemination and utilization.

Phase One: Planning

The evaluation started on August 20th when its consulting contract was perfected, however a kick-off call between OAS-DPE and the ET had taken place on August 19th to discuss DPE's expectations, understanding of the ToR, basic modus operandi, and communications.

To engage the DSD the program's implementing unit in the evaluation, online meetings between its staff and the ET occurred on August 26th, 28th and 31st. Those meetings sought to reach a mutual understanding of both the evaluation process and the programs to be evaluated. During those meetings DSD provided a great a deal of general information about the programs, as well as key data specifically tailored for evaluation purposes.

Likewise, on September 2nd an online meeting took place between the ET and DPE to discuss the CBA, its approach, methodology and expected results.

During the planning phase, the ET reviewed and discussed the evaluation ToR, clarified stakeholder's roles and responsibilities, reviewed program documents provided by DPE and DSD, drafted and refined the Inception Report, formulated a preliminary fieldwork schedule, and designed data collection protocols.

The Evaluation Design Matrix can be found in Annex A presenting a summary of data sources for each evaluation question.

Phase Two: Data Collection

The evaluation will use a mixed-methods design consisting of the following data collection methods: Document Review (DR) including literature review, an Online Survey (OS), Key Informant Interviews (KII) all online. Documents reviewed so far are listed in Annex D

The data collection protocols can be found in Annex B. The purpose of the protocols is: i) to ensure all key issues are covered during data collection, ii) to elicit rich, sometimes unanticipated information from respondents, iii) to help organize information in a form that can be usefully and efficiently analyzed, and iv) to ensure that sex-disaggregated data is collected. The protocols consist of questions that fulfill the evaluation criteria, address the EQs, and contribute to the Cost-Benefit Analysis (CBA) and a Case Study that will be discussed on data analysis section of this Inception Report.

Data Collection Methods

Document Review: The ET has started a review of documents produced by OAS to better understand M4SET and M4EE, their design, implementation and ongoing outcomes, aiming initially to overall informing the evaluation design as well as the data collection protocols development so that they properly complement and/or cross-check information obtained during document review. Documents, including literature, reviewed so far are detailed in Annex B

Key Informant Interviews (KII): Findings from KIIs will contribute answer to all EQs. KIIs will be conducted online either one-on-one or in small groups, as appropriate, with representatives of the following stakeholder groups:

1. Project Implementation Team (DSD)
2. Project Evaluation Supervision Team (DPE)
3. Donors (U.S. DOS)
4. Individuals who are beneficiaries of the projects
5. Facilitators of projects' activities (trainings, exchanges, etc)
6. Representatives of partnering institutions (Banks, Academia, etc)

Sampling. The evaluation will conduct approximately 40 KIIs with key stakeholders based on a universe of 248 programs' participants (a 16% of individuals in the programs' database) having a

reference the widely accepted practice of a 10% sample for small populations[25]. The ET does not anticipate that it will be possible to achieve complete sex parity in the number of men and women included in KIIs, as many stakeholder types might be significantly of one sex. However, the evaluation will make concerted efforts to include both sexes in the KII sample as much as possible. Likewise, the CBA will consider how women benefit from more reliable energy and cleaner air.

Interview protocols that are adjustable for different types of respondents will guide each KII. KIIs will be semi-structured, meaning that the evaluators may skip questions or insert follow-up questions depending on the nature of responses provided by key informants. Interviews will last about 1 hour and will be conducted in English or Spanish depending on the interviewee. Annex C presents a tentative list of interviewees.

Online Survey: Using SurveyMonkey.com, the evaluation will target all 248 MS4SET and MS4EE stakeholders of whom DSD has proper contact information. The online survey (OS) aims to complement findings from the document review and the KIIs, by posing higher-level questions, pursue triangulation and shape the recommendations OAS is expecting from the evaluation. Online surveys are not unusual to these programs' stakeholders as DSD follows up results of program implementation by surveying its participants.

Phase Three: Data Analysis

The ET members will transcribe the KII in real time, capturing preliminary findings, conclusions, and recommendations in an Excel-based matrix that categorizes analysis by EQ. The matrix: a) ensures that the ET prepares a systematic and thorough response to each EQ, b) verifies that preliminary analysis accounts for gender and country dimensions, c) identifies any gaps where additional clarification or analysis may be necessary, and d) serves as the basis for developing the evaluation report.

Data Analysis Methods: The evaluation will use several data analysis methods to identify key findings from the collected data, as well as to draw conclusions and make recommendations. The analysis methods will be a combination of the following:

1. Content Analysis: Content analysis will entail an intensive review of program documents, related literature, KIIs and the OS data to identify and highlight evidences of M4SET and M4EE results (or lack thereof) that contributed to or inhibited achievement of program objectives. This analysis will include the programs' utilization of the Kirkpatrick methodology for training evaluation.

2. Reviewing the Theory of Change: The evaluation will review the program's logic by examining the assumptions, pathways (outputs-outcomes-purposes-goals) and logic of how and why the program was expected to obtain its goals under such specific circumstances. This review will complement other analyses in assessing most of the evaluation criteria, but mainly its effectiveness.

3. Brief Case Study: As a nonexperimental research method that "provides an in-depth comprehensive description and understanding of an intervention as a whole as in its context"[26], this evaluation will be presenting a brief case study which will allow for data collected to be used in a more vivid and detailed way to illustrate the effectiveness,

[25] http://www.tools4dev.org/resources/how-to-choose-a-sample-size/
[26] Morra Linda G., Rist Ray. The Road to Results. The World Bank 2009

attribution and relevance of M4SET and M4EE. The case study will include the programs' utilization of the Kirkpatrick methodology for training evaluation

4. Cost Benefit Analysis: The evaluation will conduct a Cost Benefit Analysis (CBA) of the two programs. The ultimate objective of the CBA is to determine the Net Present Value (NPV) and Internal Rate of Return (ROI) of the program by estimating its social and economic costs and benefits.

   The proposed method is still being developed and depends in part on the available information and data. However, given current information the proposed methodology is a combination of the quantification of known costs and of the expected benefits based on outputs and where available outcomes. The CBA will further make use of a theory-based approach using the programs' Theory of Change and Logical Framework, as well as available literature on the role of metrology in the economy.

   The CBA will start with a systematic review of relevant literature in fields including: return on investment in scientific infrastructure (such as reliable metrics) in the areas of environment-related metrology and its links to energy efficiency, economic impacts of metrology and related systems, and the development of technologies for sustainable energy. The literature review will set the parameters for data and information to be collected in the KIIs and the document review. This information together with financial data will be used to determine the variables in the underlying model.

   The detail of the CBA depends on the following considerations: Clear Theory of Change / Logical Framework identifying assumptions – provided in project descriptions. This will be further developed and tested in the evaluation. Data availability – Indicators identified in the project description, information collected from participants, interviews, and public data. Examples and literature to support theory-based assumptions and model building.

   Attribution: The CBA will aim to attribute costs and benefits to the interventions. The use of literature and theory can address this challenge. Where full attribution is not possible the most likely contribution will be used as an approximation. In addition, the CBA will provide a sensitivity analysis to test assumptions.
   Any data gaps will be identified and as far as possible addressed either by data based on the literature or theory-based estimates. Data gaps will also be discussed with the OAS team to explore whether they might be able to provide the necessary information. A sensitivity analysis will further test any results to ensure and demonstrate their robustness.

   The steps to be taken to conduct the CBA will include: i) establishing the counterfactual, ii) reviewing the Logical Framework including identification of causal pathways and assumptions, iii) identification of monetizable costs and benefits including the role of metrology in the economic sectors addressed in the two projects, iv) construction of a simple model to calculate both ROI and NPV. This includes identifying a suitable inflation rate and discount factor, v) data collection, vi) test for unintended effects and a vii) sensitivity analysis.

Phase Four: Dissemination and Utilization

Following the data collection phase, the ET will present a Mid-term report describing the progress of the evaluation and the findings to date. Such report will include the identification and quantification of social and economic costs (CBA). The report will be accompanied by a Power

Point presentation. The ET will participate in a videoconference with OAS headquarters to present the report. Tentative date of the final report is October 16, 2020.

A final evaluation report analyzing and describing the execution of the supported actions; the results of the CBA; lessons learned, recommendations and conclusions; a section for sustainability and beneficiaries, among others. The report will be accompanied by a Power Point presentation. The Final Report will be presented at OAS headquarters (Pandemics permitting) on the week of November 2nd- 6th, 2020. Should travel is not feasible, the ET will participate in a videoconference with OAS headquarters to present the report

Evaluation Limitations

The evaluation faces some limitations derived from time, methodology, safety, and logistics. Timewise, they have to do with the relatively short time assigned for the evaluation to be carried out, it's urgency to be finished in early November and the fact that time has passed after some activities and so key informants might not be available anymore. Likewise, current world events, such as COVID-19, have imposed traveling restrictions to evaluators and so data collection methods such as direct observation or focus groups discussions have become impossible and therefore evaluation must rely on remote online methods, which sometimes are difficult due to technological and other constrains. Likewise, as this evaluation follows a non-experimental design, it does not involve a comparison group (such as members of the OAS which did not participate in M4SET or M4EE) and therefore cannot be completely generalized.

4. Evaluation Deliverables

Table 5 Evaluation Deliverables

Product	Expected Date (2020)
A detailed work plan and the evaluation Framework within 15 days of signing the contract.	Sept 10th
A draft Mid-term Report on the progress of the consultancy including the identification and quantification of social and economic costs and benefits and a Power Point.	Oct 16th
Final Evaluation Report including all products mentioned above and a Power Point Presentation to be presented at OAS headquarters	Nov. 2nd – 6th

5. Evaluation Team Composition

While the consulting contract for this evaluation is between OAS and Luis Bernal, given the need of undertake a CBA, as requested by the ToR, Bernal resorted to the expertise of Dr. Ulrike Hotopp to take charge of such analysis, otherwise, Bernal is solely responsible for the evaluation.

Luis Bernal MPP, is a senior international development and evaluation consultant with over 30 years' experience designing, implementing, and evaluating projects, programs and policies, mostly in Latin America and the Caribbean, across a broad range of sectors, industries and technical areas such as economic growth, small business development services, public-private partnerships, private sector engagement, governance, democracy, post conflict, peace and security, gender in development, ICT4D, sustainable agriculture, food security, poverty reduction, vocational education and training (VET), gender equality, social inclusion, institutional strengthening, capacity building and sustainable development. Bernal has extensive experience working for international donors such as the U.S. DOS, USAID, FTF, OTI, IADB European Union, UNDP, UN-General Secretariat, UN Women, ILO, and Global Affairs Canada with significant

experience on engagement with top-level public and private officials, as well as a variety of stakeholders such as businesses, women, youth, farmers, migrants, crime victims, and people with disabilities on local, national and multi-country levels particularly in Latin America and the Caribbean.

Dr Ulrike Hotopp, Thematic Lead for CBA, has over 20 years' experience as an economist in and outside of government. She worked in the UK 's Government Economic Service for 16 years, responsible for evaluations, appraisal and value for money analysis, most recently as Chief Economist of the UK's Department for Environment, Food and Rural Affairs (DEFRA), including oversight of DEFRA's contribution to the International Climate Fund. Dr Hotopp led the strategic analysis team in the Department of Energy and Climate Change, which included the analysis for the renewable energy strategy. She also led the team in the Department of Business, Energy and Industrial Strategy which developed its appraisal and evaluation methods including for regional policies. She has worked as part of the Prosperity Fund E&L team since 2018 developing the methodologies used for Value for Money and Secondary Benefits evaluation. Dr Hotopp took part in evaluations of the Colombia programme and the ASEAN Economic Reform Programme. Ulrike holds a PhD in Economics (International Trade) and an MA in International Economics from the University of Sussex. She holds a position as part-time reader for economic policy analysis at the University of Kent.

6. Evaluation Management

This consultancy will be coordinated and supervised by the OAS Department of Planning and Evaluation (DPE). The evaluator shall work in close cooperation with SEDI/DSD, which shall designate a member of their staff to facilitate the evaluation process. The evaluation process will take a participatory approach and take account of the views of all key stakeholders. The evaluator shall follow at any moment during the evaluation process, the OAS Code of Ethics and the UNEG Norms and Standards for Evaluation.

ANNEX A: Evaluation Matrix

Table 6. Evaluation matrix

Evaluation Question	Data Collection Methods & Sources	Analysis Methods
1. Were the output and outcome indicators achieved? If not, explain why.	- Document Review - KII - OS	- Content Analysis - CBA - Case Study
2. Were the results achieved attributable to the actions of the operation?	- Document Review - KII - OS	- Content Analysis - CBA - Case Study
3. If empirical attribution cannot be stablished, is there a robust theoretical attribution?	- Document & Literature Review - KII	- Content Analysis - CBA - Case Study
4. Did the project's team apply results-based management principles from its inception to its conclusion?	- Document Review - KII	- Content Analysis - Case Study
5. Were lessons learnt identified during the implementation of the projects?	- Document Review - KII - OS	- Content Analysis - Case Study
6. Was the monitoring mechanism used as an efficient and effective tool to follow-up on the progress of projects' actions?	- Document Review - KII	- Content Analysis - Case Study
7. Were there any unforeseeable/not planned results or outcomes?	- Document Review - KII	- Content Analysis - Case Study

ANNEX B: Draft of Data Collection Instruments

Table 7. KII Instrument for implementers and donors

Evaluation of M4SET and M4EE
KII 1. (Implementers & Donors)

Date:	Time:		
1. Full name			
2. Sex	F:	M:	
3. Email address			
4. Your organization / company			
5. Your country			
6. Which project did you participate in?	M4SET:	M4EE:	Both:

Questionnaire

1. Which project did you participate in M4SET / M4EE, or both?
2. In your opinion what is the importance of M4SET / M4EE?
3. Did, in your opinion M4SET / M4EE achieve its intended results? What was the most important achievement?
4. In your opinion what prevented half of the American states from participating in the project?
5. What do you think were the major strengths of M4SET / M4EE?
6. What do you think were the major weaknesses of M4SET / M4EE?
7. What were the key factors that fostered/hindered the project to achieve its outcomes?
8. Did M4SET / M4EE contribute to promote investment in metrology infrastructure for sustainable energy and clean air?
9. How did M4SET / M4EE influence policymaking for sustainable energy and clean air in LAC?
   Did the project apply results-based management principles from its inception to its conclusion?
10. Did M4SET / M4EE contribute to gender mainstreaming in metrology in LAC?
11. What, in your opinion, are the key lessons that can be learned from M4SET / M4EE regarding Metrology for sustainable energy and clean air?
12. If you were to design the project all over again, what would you differently?
13. Were there any unforeseeable/not planned results or outcomes?
14. Now that financial support from the USG is ending, how do you think program activities could carry on in the future?

Table 8 KII Instrument for beneficiaries

Evaluation of M4SET and M4EE
KII 2. (Beneficiaries)

Date:	Time:		
1. Full name			
2. Sex	F:	M:	
3. Email address			
4. Your organization / company			
5. Your country			
6. Which project did you participate in?	M4SET:	M4EE:	Both:

Questionnaire:

1. Did, in your opinion M4SET / M4EE achieve its intended results? What would you say is the most important one for your country?
2. How is metrology used in your country for sustainable energy and clean air?
3. What impact did M4SET / M4EE have on your work?
4. Are there any businesses or sectors of the economy in your country that have or are likely to benefit from what you get from M4SET / M4EE? How do you consider them particularly relevant for the innovation in your country?
5. What do you think were the major strengths of M4SET / M4EE?
6. What do you think were the major weaknesses of M4SET / M4EE?
7. Did the project contribute to any new policy in your country for sustainable energy or clean air?
8. Would you say that M4SET / M4EE was managed by results-oriented practices?
9. In your experience did M4SET / M4EE pay attention to women's role in metrology for energy sustainability and clean air?
10. What, in your opinion, are the key lessons that can be learned from M4SET / M4EE regarding Metrology for sustainable energy and clean air?
11. If you were to design the project all over again, what would you differently?
12. Now that financial support from the USG is ending, how do you think program activities could carry on in the future?

Table 9. Online survey form

Evaluation of M4SET and M4EE
Online Survey

1. Full name			
2. Sex	F:	M:	
3. Email address			
4. Your organization / company			
5. Your country			
6. Which project did you participate in?	M4SET:	M4EE:	Both:

I. Scoring the Performance of M4SET and M4EE

1. How would you rate the RELEVANCE of M4SET and M4EE for your country?

Lowest Score	1	2	3	4	5	6	7	8	9	10	Highest Score

2. How would you rate the EFFECTIVENESS of M4SET and M4EE as a program?

Lowest Score	1	2	3	4	5	6	7	8	9	10	Highest Score

3. How would you rate the quality of the DESIGN of M4SET and M4EE as a program?

Lowest Score	1	2	3	4	5	6	7	8	9	10	Highest Score

4. How would you rate the EFFICIENCY of M4SET and M4EE as a program?

Lowest Score	1	2	3	4	5	6	7	8	9	10	Highest Score

5. How would you rate the FINANCIAL SUSTAINABILITY of M4SET and M4EE as a program?

Lowest Score	1	2	3	4	5	6	7	8	9	10	Highest Score

6. How would you rate the performance of M4SET and M4EE regarding GENDER MAINSTREAMING in Metrology?

Lowest Score	1	2	3	4	5	6	7	8	9	10	Highest Score

II. Your opinion on the Achievements of M4SET and M4EE

Please express the degree of your agreement with the following statements related to M4SET and M4EE achievements.

7. Due to M4SET and M4EE my knowledge of metrology applicable to air quality, energy efficiency or sustainable energy has increased.

I Strongly disagree	I disagree	Neutral	I Agree	I Strongly Agree	I do not know / do not want to answer

8. M4SET and M4EE led to the deployment of sustainable energy technologies that foster low carbon economic growth in my country

I Strongly disagree	I disagree	Neutral	I Agree	I Strongly Agree	I do not know / do not want to answer

9. M4SET and M4EE strengthen the technical and technological capabilities of the metrology community in my country in the fields of energy efficiency, renewable energy, air quality and greenhouse gases in beneficiary countries

I Strongly disagree	I disagree	Neutral	I Agree	I Strongly Agree	I do not know / do not want to answer

10. Due to M4SET and M4E has adopted new policies on sustainable energy in my country

I Strongly disagree	I disagree	Neutral	I Agree	I Strongly Agree	I do not know / do not want to answer

III. Your opinions regarding M4SET and M4E's Implementation

11. As a program, what do you think are the most significant changes that M4SET and M4E's achieved? (Please elaborate as much as you wish)

12. As a program, what do you think are the major Strengths of M4SET and M4E's? (Please elaborate as much as you wish)

13. As a program, what do you think are the major Weaknesses of M4SET and M4E's? (Please elaborate as much as you wish)

IV. And for the Future…

14. If you had to start M4SET and M4EE all over again, what would be your two major recommendations to make it better? (Please elaborate as much as you wish)

Annex C. People Interviewed

N/A

Annex D. Documents and Literature Reviewed

1. Renewal Energy and Climate Science (RECS) Challenges and Technology Challenges in the Americas
2. SID 1605. Project Document. Advancing Metrology for Energy Efficient Measurements and Compliance in Central America and Dominican Republic
3. SID 1605. Budget
4. SID 1605. Adjustments to Project LFM 10.26.2017
5. SID 1605. Adjustments to Project LFM 09.12.2018
6. SID 1605. Reports on Progress of Project Implementation Report (Jun 2017-May 2020)
7. SID 1606. Project Document. Advancing Metrology for Sustainable Energy Technologies and the Environment in the Western Hemisphere - Second Phase.
8. SID 1605. Budget
9. SID 1606. Adjustments to Project LFM 04.24.2017
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11. SID 1606. Adjustments to Project LFM 09.11.2018
12. SID 1606. Reports on Progress of Project Implementation Report (Jun 2017-May 2020)
13. M4SET, M4EE Project Proposal Application Package
14. M4SET, M4EE Training Evaluation Methodology
15. CLASP. Panorama de los mercados de iluminación en los países del Sistema de Integración Centroamericana (SICA). Abril 2020
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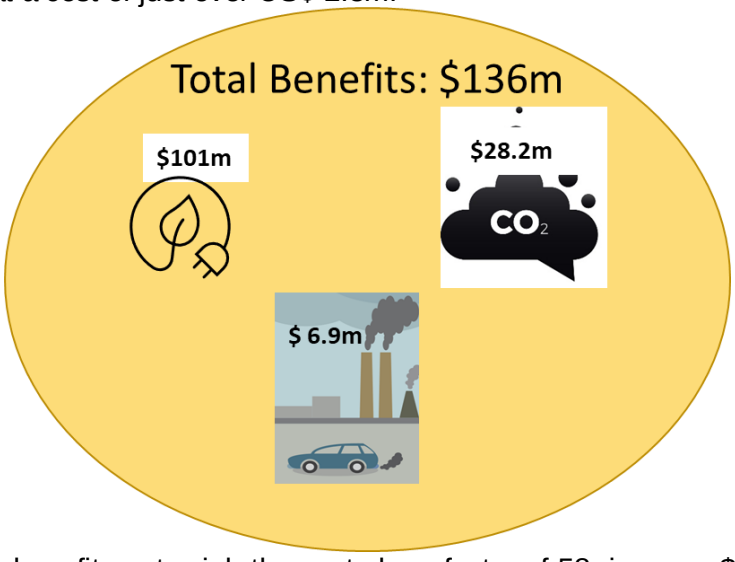
Annex E. Cost-Benefit Analysis

Contents

1. Cost Benefit Analysis

Summary

The OAS programs evaluated in this report contribute significantly to the economy and well-being of the people of Southern and Central America. In total the OAS's contribution alone is estimated to be US$ 136.6m at a cost of just over US$ 2.3m.



This means that the benefits outweigh the costs by a factor of 58, ie every $ invested leading to $58 of benefits. The net present value of the benefits is $134.1m and the Return on Investment is estimated at 57.7.

The main contributors to these benefits are:

- Energy efficiency in the household of $ 101m
- Increase in business productivity due to reduction in air pollution $ 6.9m
- Reduction in carbon emissions $28.2m.

The OAS interventions are a catalyst and enabling driver for change. Many other factors will contribute to the changes that lead to benefits, which in total are very much larger than those presented here.

In addition, there are many benefits which cannot be quantified. These include

- the feeling of safety on streets,
- improved products in OAS member states manufacturing
- rising rates of innovation

An estimate of the potential positive impacts for women of improved street lighting was estimated to be more than $ 230m.

The estimates provided in this chapter are using the Theory of Change described above and empirical evidence of policy impacts from across the world. They are estimates and therefore uncertain. However, the analysis has in all cases aimed to err on the side of caution and rather underestimated than overestimated the results.

1.1 Introduction

This section summarizes the cost benefit analysis for the evaluation of SID 1605 and 1606. SID 1606 and 1605 included a total of 11 projects covering training, technical cooperation and more.[27] The cost benefit analysis considers these projects as one programme aiming to achieve wider objectives for energy efficiency, energy quality and air quality. It assesses the benefits in aggregation. Where a subgroup of countries has brought forward a proposal the analysis focuses on these countries.

A CBA assumes that observed or theory based expected changes are caused or partly caused by the intervention analyzed. This is also the case here. As set out by Coglianese (2012) in the Expert paper for the OECD in a theory based evaluation such as this "*with regulatory policy … confounders need to be considered*" as many factors influence the individuals and institutions whose behavior needs to change to ensure outcomes are achieved.[28]

It further must be noted that this evaluation does not include data collection from end beneficiaries, ie consumers, businesses etc. The CBA is therefore based on economic theory and available evidence, including literature. Due to this the CBA takes a cautious approach to the identification of benefits and provides the lower boundary of a range used for calculation to avoid overestimating benefit.

The quantitative analysis covers a period of 10 years (unless stated otherwise) after the desired impact has occurred. However, there is a lag between the capacity building intervention of the OAS and the implementation of measures at the country level. The detail of this lag is presented in the methodology annex. Based on a KII the assumed lag differs between interventions due to the expected length of the policy making process.

Many of the benefits assessed here are still due to occur in the future. The OAS interventions occurred over the last 2 years, while the expected lag until policy implementation is between 3 and 5 years.

This chapter is structured in the following way: Each group of beneficiaries, consumers, business, and governments are analyzed in their own subsection. These subsections are structured by the three areas of energy efficiency (lighting and air conditioning), energy quality and air quality. These three subsections are followed by a subsection on carbon emissions. Table 10 summarizes the benefits and costs. The Excel spreadsheet used for the calculation will be made available to the OAS after completion of the analysis.

Table 20. Method for monetization - summary

	Monetized benefit
Energy efficiency -lighting	Household savings in energy bills Local authorities' energy savings
Energy efficiency – air con	
Energy quality	Labor force productivity (total labor force)
Air quality	Labor force productivity (urban labor force)
CO2 emissions	Carbon price of reduced emissions

[27] Source: powerpoint provided by OAS Metrology Program for Energy & Environment
[28] Coglianese, 2012

1.2 Description of the intervention and Theory of Change expected outcomes

The work of the OAS builds capacity in partner countries by using 4 main mechanisms:

- Awareness raising (including networking of decision makers)
- Training
- Technical exchange and
- Technical Assistance[29]

The Theory of Change [described in section 2 of this report] demonstrates the links and causal pathways which must apply in order for this capacity building and training to have the desired outcomes and impacts. These outcomes and impacts are:

- Improved security of supply (in quantity and quality) of energy to consumers and businesses,
- Increased energy efficiency leading to less energy demand and reduced household and business spending on energy
- Reduced emissions caused by electricity generation,
- Improved air quality measurement and related reduction in ill health.[30]

Women, children, and other vulnerable groups are likely to benefit disproportionately in terms of health benefits, increase safety (street lighting) and reliable use of household goods.[31]

One important pathway for benefits is the development and application of new technology. Technical exchange increases innovative capacity and absorptive capacity to implement innovations which occurred elsewhere. This has not been further analyzed here. It would be necessary to conduct more specific data collection to enable a monetization of these benefits.

1.3. Benefits and Costs

Benefits accrue to three groups of beneficiaries.

- Consumers, who have been grouped in households,
- Business, with a specific focus on small business where data allows and
- Government (local and national).[32]

These groups have been used to structure this analysis. Only the main benefits have been quantified where possible for each of these groups. Where quantification across a whole group was not possible due to lack of data, illustrative examples have been used to demonstrate the opportunities for financial benefits.

It must be taken into consideration that most of the products such as LED lightbulbs and efficient air conditioning are already available in the market.

[29] The types of intervention are described in the project documents for projects 1605 and 1606 and note repeated here.
[30] The evidence related to these statements is provided in the sections below.
[31] The evidence for this is provided in section 1.3.3.2
[32] Note that the interviews did not include end beneficiaries, ie consumers or business. The benefit is based on known behaviors which have been observed elsewhere.

Table 11: Quantified attributable net benefits in US$m

Group	Benefits in US$ m
Consumers* - energy efficiency	101
Business** – air pollution	6.9
Government	n.a.
Carbon reduction benefits*	28.2
Total	136.1

Source: OAS and UN data and own calculation

Notes:

* Include benefits for SICA countries only (apart from Belize for which data were not available.)

** Data available for: Argentina, Belize, Brazil, Costa Rica, El Salvador, Guatemala, Honduras, Panama, República Dominicana, Uruguay

As summary *Table* above shows the attributed benefits outweigh the costs to the OAS by a factor of 58.7
The net present value is US$134.1m and the Return on Investment is 57.7.

1.3.1. Consumers

1.3.1.1. Energy efficiency

Consumers benefit from the increased energy efficiency of key consumer products such as lightbulbs and air conditioning units mainly by a reduction in the amount of disposable income they have to spend on energy.

Lighting[33]

There is an upfront cost of purchasing energy efficient LED light bulbs. Over the period analysed (3 years lag of policy implementation following the OAS intervention, 5 years lag of consumer adoption following legal implementation and 10 years period of analysis)[34] the longer life of the LED bulbs means that consumers have to buy fewer of the less efficient incandescent light bulbs. In the calculation for the cost benefit analysis the price of the lightbulbs has not been included in the calculation. This is because the costs to consumers of the more expensive LED lightbulb are likely to be balanced out by savings caused by avoiding purchases of incandescent lightbulbs over the 10-year period.

The benefits to households arise from substantive energy saving which reduce household bills. Table presents the calculation for 7 countries for which specific data were provided by the OAS. These are the energy savings which have been attributed to the OAS activity.[35]

Box 1 Impact of street lighting on crime – 2 examples

Mexico City

"Es decir, el buen funcionamiento de los servicios de mantenimiento urbano de luminarias y parques importa igual o más que policías armados y patrulleros con alta tecnología." (IADB, 2015)

New York City

"… estimate that the introduction of marginal [street] lighting reduced outdoor nighttime index crimes by approximately 60 percent, and, by at least 36 percent once potential spatial spillovers are accounted for. These findings provide the first evidence that the physical environment of cities and communities is a key determinant of

[33] The monetization of benefits to consumers has been conducted for a change of incandescent light bulbs to LED. There are other light bulbs available such as halogen.

[34] An incandescent light bulb lasts for about 1000 hours of use which is likely to be less than a year. This compares to 15000 hours for an LED light bulb. The LED light bulb costs 8 times the price of an incandescent. The assumptions that the costs for the purchase of light bulbs over the time period is therefore very prudent. See OAS cost effectiveness spreadsheets for light efficiency policies for prices and lifetime.

[35] For the method see methodology note in annex.

Overall the monetized energy savings are significantly higher. But there will be other factors contributing to the switch to efficient light bulbs.[36]

Consumers also benefit from the use of more efficient street lighting (ie national and local government implementing the use of more efficient LED street lighting) because increased lighting increases safety by reducing accidents[37] and leads to a reduction of low level crime such as muggings.[38] *Box 1* provides two examples. The victims of crime survey in Mexico City reveals that 40% of all respondents considered improved street lighting as the most important factor in reducing crime levels.

This will benefit women in particular, and provide them with more choice to leave the house to go out to work etc. This benefit has not been quantified because many other factors influence the decision of going out to work and the evaluation team considered the lack of specific evidence did not allow for an estimate. See 1.3.1.4 for further detail.

Air conditioning

The increased energy efficiency of air conditioning units will increase the comfort in the home and reduce energy bills. However, no data was available to estimate the difference made by the OAS intervention. The improvement in well-being will depend on temperatures. For example, in Brazil, Brasilia, the annual temperature does not vary a lot between months. The top however can be just under 30°C, which according to evidence by the Global Health Action (Kjellstrom, T) already reduces well-being and productivity.[39]

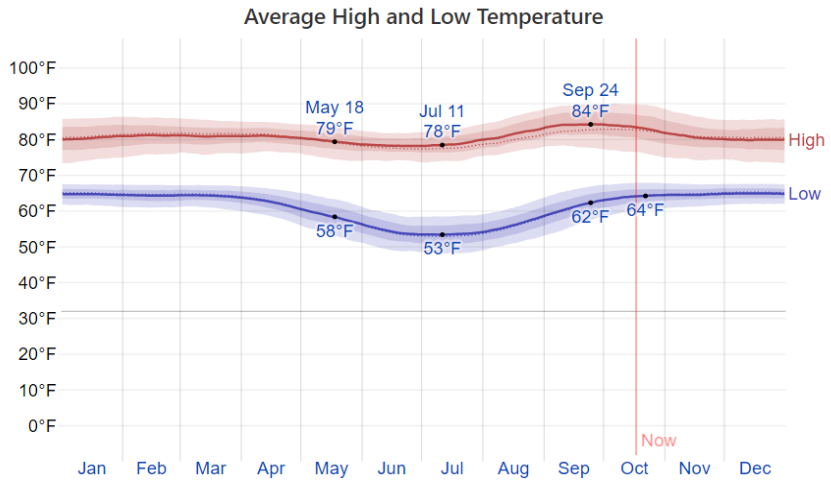
[36] We note that the report by CLASP (2020) shows a benefit of energy efficient lighting of $257m. This includes benefits to households, business, and municipalities. Given the different groups included in this calculation we believe that this illustrates that the estimates presented here are a prudent and therefore reliable estimate of the potential benefits.

[37] The Royal Society for the Prevention of Accidents, May 2018, Street Lighting and Road Safety, https://www.rospa.com/rospaweb/docs/advice-services/road-safety/roads/street-lighting.pdf

[38]. Chalfin, Aaron, Benjamin Hansen, Jason Lerner, Lucie Parker, Reducing Crime Through Environmental Design: Evidence from a Randomized Experiment of Street Lighting in New York City, NBER Working Paper No. 25798, Issued in May 2019

[39] More on productivity impacts in the section on business.

Figure 4 Average temperature in Brasilia

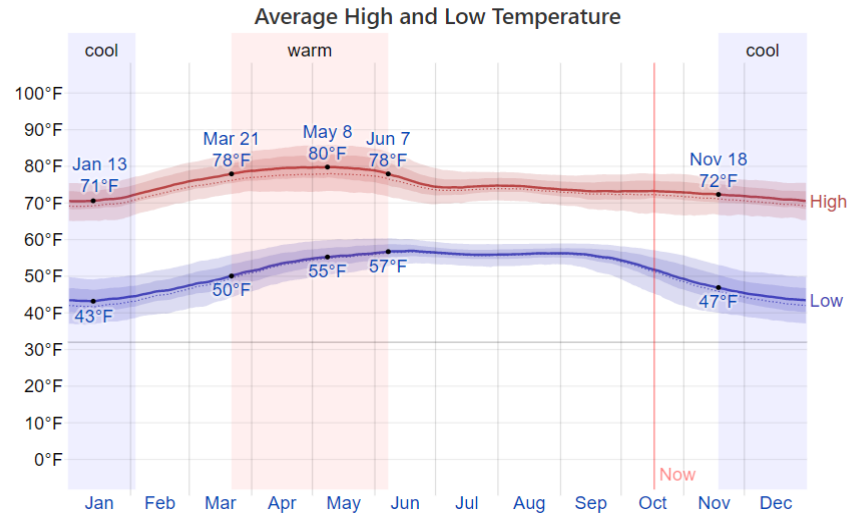


The daily average high (red line) and low (blue line) temperature, with 25th to 75th and 10th to 90th percentile bands. The thin dotted lines are the corresponding average perceived temperatures.

Source: https://weatherspark.com/y/30238/Average-Weather-in-Bras%C3%ADlia-Brazil-Year-Round

While in Mexico City temperatures can be more extreme.

Figure 5. Average temperature in Mexico City



The daily average high (red line) and low (blue line) temperature, with 25th to 75th and 10th to 90th percentile bands. The thin dotted lines are the corresponding average perceived temperatures.

Source: https://weatherspark.com/y/5674/Average-Weather-in-Mexico-City-Mexico-Year-Round

This Cost Benefit analysis cannot estimate the potential benefits for every region of the countries under consideration which are very diverse. However, these two charts show that there is likely to be demand for air conditioning.[40]

Overall it has to be noted that while energy bills are likely to fall as equipment is becoming more efficient there will also be benefits as consumers feel able to use more light and air conditioning

[40] The analysis of benefits to business makes further use of the weather data.

because they can afford it.[41] "*Heating, ventilating and air conditioning (HVAC) systems are of great importance to improve indoor environment quality (e.g. indoor air quality, thermal comfort, etc.). However, it may cause significant energy consumption*….".[42] Again the ability to use the air conditioning more often increases comfort and wellbeing even if energy use is not falling.

Monetized benefits
The benefit analysis demonstrates that monetized benefits attributable to the OAS project evaluated here across the countries of Southern and Central America in total can be significant. Table provides estimates of energy savings for 7 SICA countries for which the relevant data were provided.

Table 12. Attributable savings in energy costs to households in 7 SICA countries

Country* In US$ m	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua	Panama	Dominican Republic	All
Household benefit in PV over 10 years (country spec saving figures) incl 5 year lag	7.60	14.90	38.50	4.50	8.40	7.10	10.10	101

Source: OAS and UN data and own calculation

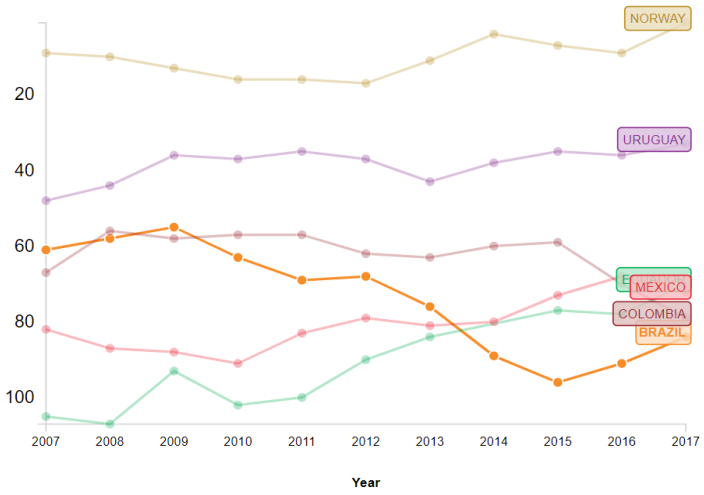
Notes:
Assumption: Average household size 6 persons. Each household changes 1 lightbulb to and LED lightbulb. The period of analysis is 10 years. Values are discounted using a 3.5% discount rate.
*Included are countries for which OAS provided information on costs, energy savings and RoI
Specific data on energy use, cost of LED lightbulbs and electricity and therefore related savings were only provided for the 7 countries included in Table . In order to provide a rough estimate of similar benefits occurring to consumers in the other countries more general information was used for the other countries. See the methodology annex for further detail. The estimates provided in are likely to be lower bounds as these are significantly below those in Table .
The total benefits over all countries of Southern and Central America are estimated at US$239m.43 Detailed data for the other countries is in Table in the annex.

1.3.1.2. Energy Quality

The impact of the energy quality measures is assessed for the five countries who initiated the Energy Quality project and took part in it. Figure 6 shows the development in energy quality in the 5 participating countries over time and in comparison, with the best performing country, Norway. This demonstrates the challenge countries in the region are facing.

[41] In economics this is called the Rebound Effect. See S. Sorrell
[42] Cao 2020
[43] This total estimates the savings for those countries for which no specific data were available by using a generic per household saving of US$20 based on https://www.energystar.gov/products/lighting_fans/light_bulbs. This is likely to be a significant underestimate. For detail see Annex.

Figure 6. Quality of Electricity Supply, 5 participating countries - and Norway, 2007 - 2017



Source: World Bank Group, https://tcdata360.worldbank.org/indicators/ha7db856d?country=BRA&indicator=548&countries=COL,ECU,MEX,NOR,URY&viz=line_chart&years=2007,2017

Households benefit from energy quality improvements by a reduced need to replace electrical equipment such as white goods, TVs, radios, computers damaged by changes in the electricity supply due to low energy quality. It impacts on the quality of consumption and comfort as well as the ability for any home production.[44]

Improvements in energy quality enable consumers to make a wider choice of the equipment they feel able to buy as they are not concerned about damage occurring to it.

These benefits have not been quantified due to lack of data on use of electrical equipment in households.

1.3.1.3. Air quality

Improvements in air quality benefit all those living, working, and commuting through areas of high air pollution. The work of the OAS contributes to improved and more reliable measurement of pollutants which ultimately is likely to lead to reductions in air pollution. Air pollution negatively impacts on people health and life expectancy. For Mexico, according to the Copenhagen Consensus

…. air pollution kills nearly 33,000 Mexicans every year. Nearly 20,000 of these deaths are due to outdoor air pollution, mainly in towns and cities. The remaining 13,000 are from household air pollution, caused by cooking with wood and other solid fuels.[45]

The benefits from reduction in air pollution arising to consumers include improved health which impacts on adult's ability to work and earn an income as well as to general wellbeing. In vulnerable people such as children and the elderly air quality improvements increase life expectancy as well as quality of life. It reduces occurrences in asthma in children which has long term impacts and mortality in elderly leading to longer and healthier lives.

[44] A study for rural India found: a grid connection and a higher quality of electricity (in terms of fewer outages and more hours per day) increases non-agricultural incomes by about 28.6% in the same period. In Chakravortya et al, 2014

[45] https://www.copenhagenconsensus.com/publication/mexico-perspective-air-pollution#:~:text=According%20to%20the%20World%20Bank,wood%20and%20other%20solid%20fuels.

Table 13. Air pollution Impact on human health

Pollutant	Health effects at very high levels
Nitrogen Dioxide, Sulphur Dioxide, Ozone	These gases irritate the airways of the lungs, increasing the symptoms of those suffering from lung diseases
Particles	Fine particles can be carried deep into the lungs where they can cause inflammation and a worsening of heart and lung diseases
Carbon Monoxide	This gas prevents the uptake of oxygen by the blood. This can lead to a significant reduction in the supply of oxygen to the heart, particularly in people suffering from heart disease

Source: https://uk-air.defra.gov.uk/air-pollution/effects

1.3.1.4. Impacts on Women

Impacts on women arise mainly due to their activity and how the technologies introduced affect their ability to act differently.

In the case of energy efficiency, especially with respect to street lighting we assume that more women might go out to seek paid employment.

The monetization of this potential benefit was challenged by a lack of data. An estimate assumes that these benefits could be of the order of US$ 284m[46], whereby the assumption is that female employment in urban areas increases by 1 percentage point in countries where it is below the average of 45%. Data for wages of female employees were available for 9 countries whereby the figure for Costa Rica appears to be incorrect.[47] For those countries where the average share of female employment was below 45% and no specific data were available, the average (without Costa Rica) has been used.

1.3.2. Business

Benefits to business arise from a number of sources linked to increased energy efficiency, quality and air quality. Not all of these have been quantified here. In addition, confidence in some of the products produced domestically which now can be tested using the improved measurement systems and capacities should increase the demand for domestic products compared to imported products.

1.3.2.1. Energy Efficiency in Business

Just like consumers businesses are likely to benefit from reduced energy costs due to the increased use of more efficient lighting and air conditioning.

[46] Source: Data: ILO: labour force
https://www.ilo.org/shinyapps/bulkexplorer44/?lang=en&segment=&id=EAP_2EAP_SEX_AGE_GEO_NB_A
Wages: https://www.ilo.org/shinyapps/bulkexplorer6/?lang=en&segment=&id=EAR_4MMN_CUR_NB_A
And own calculations

[47] Argentina, Belize, Brazil, Costa Rica, Dominican Republic, Guatemala, Honduras, Panama, El Salvador

Businesses who have inefficient air conditioning are likely to stand significant benefits from increased energy efficiency in this equipment: air conditioning can account "*for more than 50% of the total building energy consumption, especially for public/non-residential buildings".*[48]

Business it are also likely to benefit from increased productivity. *Box 2* quantifies the potential for savings in the case of office workers in Thailand.

Research by Hyatt et all (2010) provides more evidence for the physical causes of reduced productivity of workers working in unsuitably high temperatures. Climate change is likely to exacerbate these effects further (Kijlstrom, 2009)

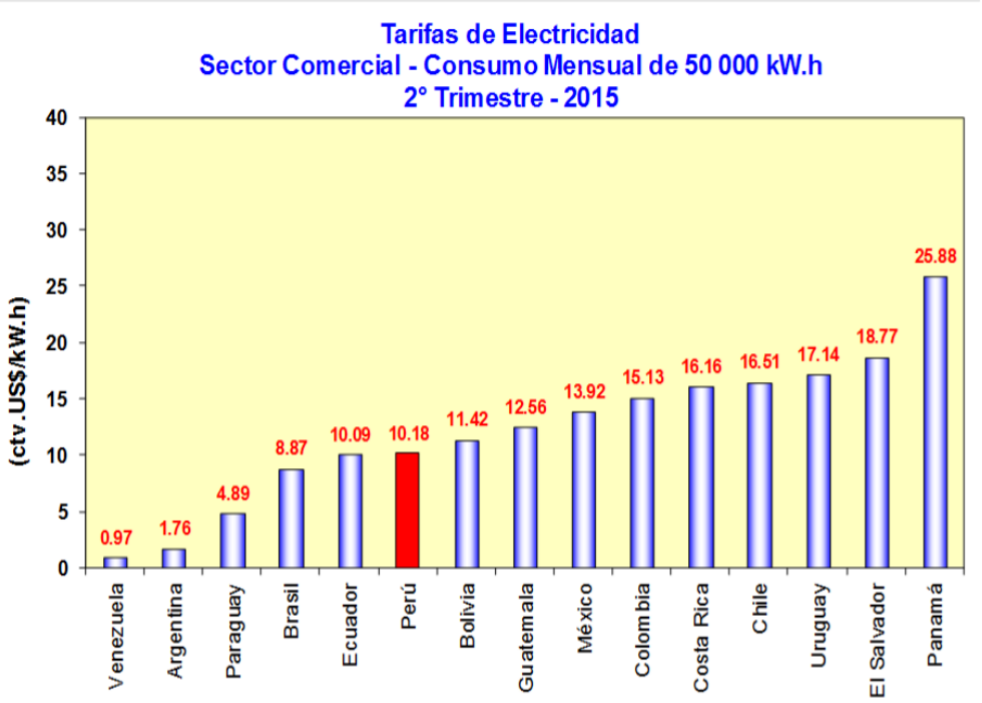
To calculate the benefits to business of reduced energy use electricity prices for businesses are required. *Figure* provided prices for commercial electricity users by two sizes: 50,000 kWh per month and 500,000 kWh per month reflecting the fact that large electricity users will be able to negotiate favorable prices.

Box 2 Air conditioning and productivity

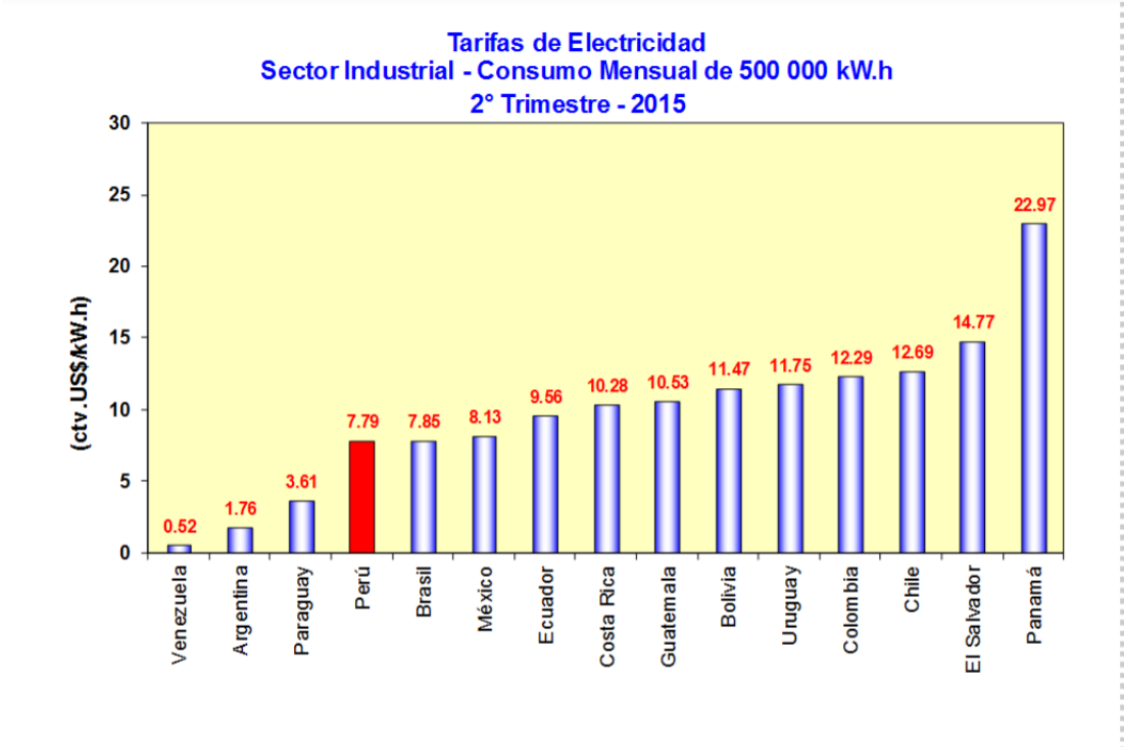
"….26 °C–28 °C for morning periods and at 24.5 °C–26 °C for afternoon and evening periods. These ranges of temperature settings help maintain and improve the productivity of office workers during morning, afternoon, and evening periods by 18%, 1% to 15%, and 7%, respectively"

Source: Ngarmpornprasert, 2010

Figure 7. Electricity prices for business by usage



[48] Cao, 2020



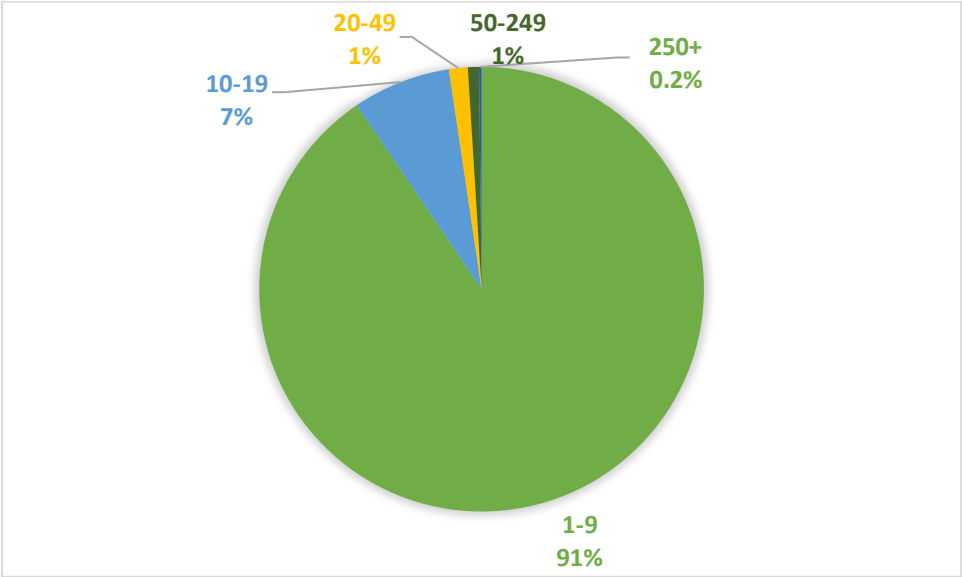
Source: Ministerio de Energía y Minas, Peru, 2016

Small companies, ie those using less electricity are likely to benefit more from energy efficiency measure because they pay a higher price per kWh than more intense electricity users. Most companies in the countries analysed here (and elsewhere) are small and medium sized companies.

Illustrative example: Mexico

Figure shows the split between small, medium, and large companies (by employee number) in Mexico. 91% of Mexican non-agricultural companies are small, ie employ between 1 and 9 workers.

Figure 8. Mexican companies by size (employees) in %



Source: OECD Structure snd Performance Of The Enterprise Population, 2017

The total reduction in business costs has not been estimated. However, *Box 3* provides an example for the savings potential for Mexico's small business community.

Box 3 Example: Small businesses in Mexico switching to LED from incandescent

Using the Mexican business population, and assuming that businesses of up to 50 employees use 50.000 per months, ie paid 13.62 cent/kwh a change from an incandescent lightbulb to LED in 10% of these 3.2 million businesses would save them around US$ 3.4 m in total.
Source: OECD, 2017, OAS data and own calculation

A further business benefit arises for those companies who produce LED lightbulbs, equipment which includes LED lighting and air conditioning in the partner countries. However, it has not be possible to quantify these benefits as part of the evaluation.[49]

1.3.2.2. Energy quality in business

The improved energy quality will have similar benefits to businesses using electrical equipment.

Box 4 Impact of low-quality electricity on business

Possible consequences of low power quality that affect business costs are:

- Power failures (Release switches, fuses blowing).
- Breakdowns or malfunctions of machines.
- Overheating of machines (transformers, motors, etc.) leading to reduced useful life.
- Damage to sensitive equipment (computers, production line control systems, etc.).
- Electronic communication interference.
- Increased distribution system losses.
- The need to oversize systems to cope with additional electric stress, resulting in higher installation and operational costs.
- Luminosity flickering

Source: https://www.icar.com/en/le-3-cause-principali-di-un-basso-power-quality/

MSMEs are most likely to benefit from a reduced need to replace equipment which has broken due to variation in the electricity supplied to them. In some cases of micro businesses this might mean that a business continues as the investment in new equipment might not be affordable to them.

The electrical equipment used by businesses is very diverse and not sufficient data was identified. In addition, to the benefits arising from the use of electrical equipment, which most likely covers all businesses there are also those businesses producing electrical equipment. There are likely to be two counterbalancing effects: On the one hand the reduced need of businesses and consumers to replace their equipment means there might be a somewhat reduced demand. On the other hand, those businesses and consumers have more trust that the products they are buying will not be negatively affected by changes in energy quality, raising the demand.

The increased confidence in the domestic production of electricity using equipment may impact on the export opportunities for domestic businesses. The CBA has not been able to quantify these impacts.

[49] It is not known whether there are any such companies in the countries analyzed.

1.3.2.3. Air quality

The ToC assumes that an increased ability to measure air pollutants will lead to an increase implementation of air quality policies. The benefits described for consumers above will only be realized once local and national government have made these changes. However, the improved measurement is a key enabling step to do so.
The benefits of reduced air pollution accruing to individuals will translate into their ability to work, if they are of working age. The reduced negative impact on their health is likely to lead to increases in productivity. As Neidell concludes: Improvements in air quality have led to significant increases in worker productivity.[50]

In economic labor productivity can be measured in the wages that workers are paid. While this is an approximation it is prudent to express an increase in productivity as a (small) percentage in the wage, even if it is not accompanied by an actual wage increase. It is difficult to find accurate measures of the loss of productivity caused by high levels of air pollution. In the CBA we assume a value in the range of between 0.5% and 2%. Further assumptions are in the methodology not in the annex.
Different areas in towns and cities will be affected in different ways, depending on the take up by local government and implementation of measures. The CBA makes assumptions about this to ensure that there is no overestimate of benefits.

For the 10 countries for which the wage data were available an annual attributable benefit of US$6.6m has been estimated.

The quantified CBA looks in particular at the impact of reduced morbidity in working age adults. Reduces instances of ill health and increased productivity increases their ability to earn an income.
The benefits to business as calculated here, attributable to the OAS projects are presented in 14.

Table 14. Estimate attributable benefits to business from improved air quality, in US$ 000s

Country In US$ 000s	Argentina	Belize	Brazil	Costa Rica	El Salvador	Guatemala	Honduras	Panama	Dominican Republic	Uruguay	All
Business benefits	962	4	4,891	57	64	127	87	139	147	110	6,588

Note: Currently a number of countries missing due to data availability. Calculated as present value over 10 years
The literature (Neidell, 2017) shows that the hours worked do not change for those workers in employment. This means that there is no impact on their wages unless employers proactively increase wages.

1.3.3. Governments (local and national)

1.3.3.1. Energy efficiency

Governments, like businesses, are likely to benefit from improved energy efficiency by LED lighting within offices and more efficient air conditioning.
In addition, there are saving opportunities by changing street lighting to LED lights. 15 provides illustrative saving opportunities for those 7 countries for which OAS provided detailed information.

[50] Neidell, Matthew, 2017

There is not sufficient information about the number of streetlights in each municipality, their type and their use in order to calculate a total saving.

Table 15. Energy efficiency - lighting Illustrative saving opportunities for municipalities

Savings in US$ over 19 years	Costa Rica	El Savador	Guatemala	Honduras	Nicaragua	Panama	Dominican Republic
Saving per streetlight	$727	$1,102	$1,206	$1,675	$726	$1,516	$718
Number of municipalities	8	14	22	18	15	10	31
If each municipality changes one light	$5,814	$15,428	$26,526	$30,149	$10,894	$15,160	$22,267

Source: Online sources for number of municipalities per country, OAS data and own calculation

In addition, municipalities are likely to benefit from reduced crime and accidents as street lighting improves.[51] These benefits have not been quantified.

1.3.3.2. Energy quality

Like businesses and consumers Government benefits from reduction in the damage to electrical equipment in offices and other electrical equipment caused by low energy quality.

Wherever business benefit and is able to increase is productivity and profits this will ultimately also benefit government due to increase tax intake.

1.3.3.3. Air quality

Improved air quality reduces incidents of ill health in the population fall. Reduced spending on ill health will benefit health budgets across the region. This has not been quantified due to lack of data.

1.3.4. Carbon reduction benefit

Carbon trading (Emissions Trading Systems) or Carbon Taxes are not yet implemented in many countries, however many of the countries discussed here have them under consideration, as 9 shows.

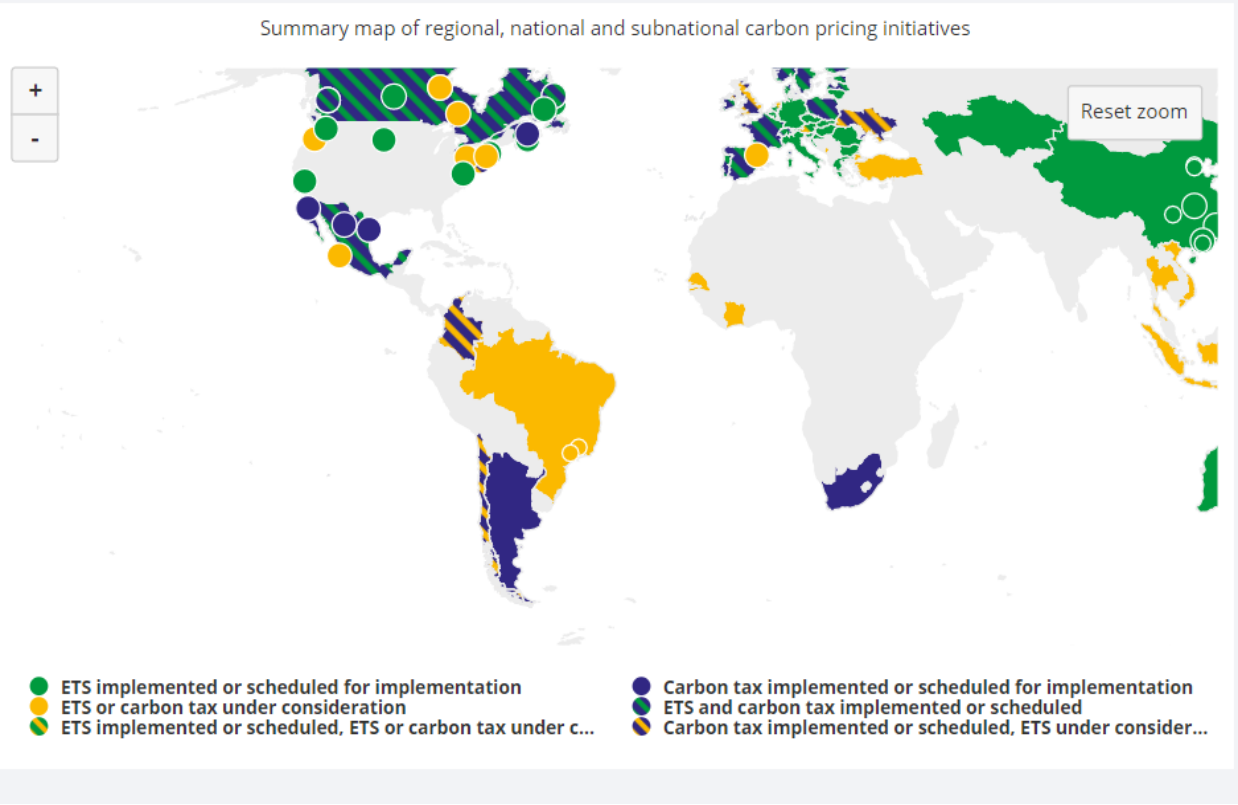
The available carbon prices from this region were used to identify an upper and lower range for a carbon price for the valuation of the carbon saved by the energy efficiency initiatives, supported by the OAS.[52]

The monetization of these benefits uses only the energy efficiency caused by the change of one light bulb from incandescent to LED per household. It is therefore illustrative and can be used to describe the effect that a small change can have if implemented by a large number of households.

[51] Chalfin, A, 2017

[52] There are a number of different carbon pricing systems: Emissions Trading Systems and Carbon Taxes are both systems which use a price for emitted carbon either on a permit or carbon market or as a tax imposed on emitting activities. Detail on these systems can be found on: What is Carbon Pricing https://carbonpricingdashboard.worldbank.org/what-carbon-pricing

Figure 9 Map of Central and South American countries with a carbon pricing policy



Source: https://carbonpricingdashboard.worldbank.org/map_data

Using a range of available carbon prices of US$ 5 in Chile and US$ 11.26 in Zacatecas per tCo2e leads to the following values of CO2e saved in the countries discussed here (excluding Canada and the USA).

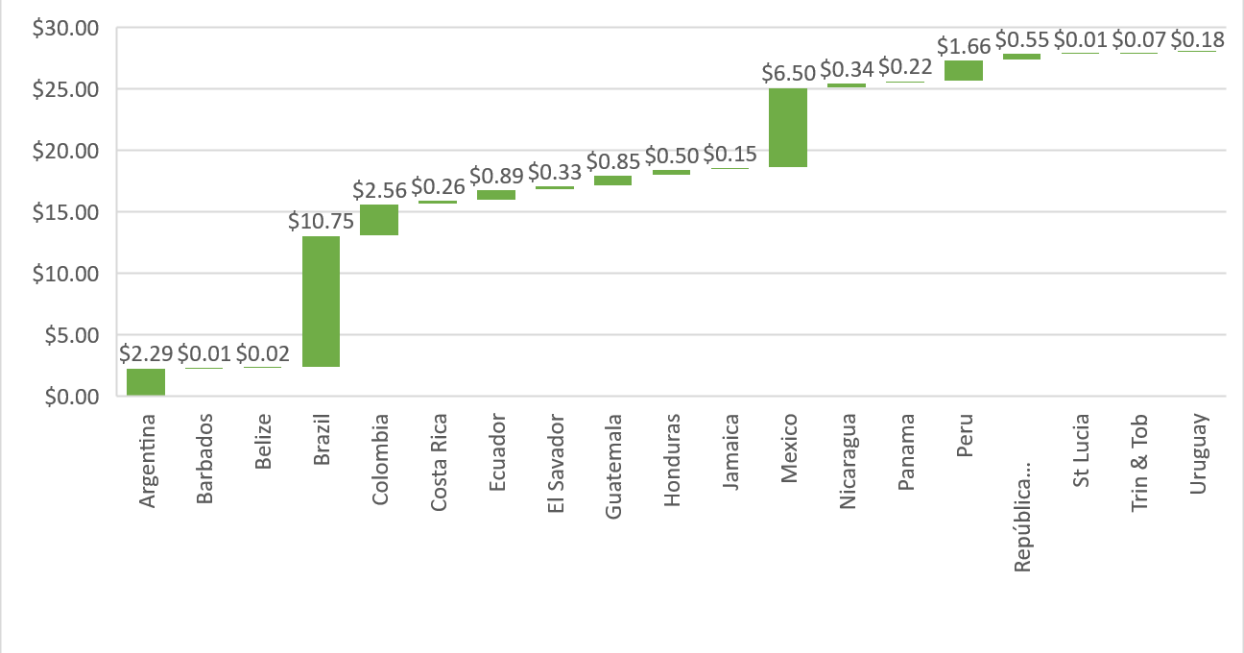
Table 16. Carbon savings from energy efficiency measure (lighting)

	Co2 savings, all countries in US$m
in US$m low	$28.12
in US$m high	$63.33

Source: Data provided by OAS, World Bank Group and own calculations

Figure 10 illustrates how this value (the lower boundary) is reached by the countries' contributions.

Figure 10. Country contribution to overall CO2 savings, lower bound, in US$m over 10 years



Source: Data provided by OAS, World Bank Group and own calculations

1.4. Costs

All three groups analyzed here (consumers, business and governments) may be subject to costs in the form of stranded assets. Stranded assets are equipment which can no longer be used due to changes in the regulation or disruptive innovation. (For more on stranded assets see Green and Newman [53])

In the case of the policy considered here which could arise out of the projects conducted by the OAS these could be incandescent lightbulbs, motor vehicles (cars, vans and trucks or other assets which burn fossil fuels and lead to air pollution) etc. It will depend on how and when changes in regulations are implemented. It is possible to minimize the costs by shaping the regulations accordingly. They have not been quantified in this CBA due to lack of data.

There is a potential for stranded assets in all areas of intervention. However, if the interventions are brought in over a number of years and with sufficient prewarning so that people and businesses can adjust in time it is likely that the resulting costs are negligible.

Other costs such as the higher prices of LED bulbs will over time balance out the reduced need to purchase such lightbulbs.

1.5. Summary

Table summarises the costs and benefits analyzed in this chapter.

[53] Green, Jemma &Peter Newman Disruptive innovation, stranded assets, and forecasting: the rise and rise of renewable energy Pages 169-187 | Received 08 Jul 2015, Accepted 23 Nov 2016, Published online: 22 Dec 2016

Table 16. Benefits and costs register: Energy Efficiency, Energy Quality and Air Quality

	Consumers	Business	Government
Energy efficiency: ▪ Lighting	Benefits ▪ Reduced energy bills in the home (might affect women working at home - ▪ Reduced spending on luminaires (after first spending higher than previously) ▪ Improved safety on streets due to better streetlights ▪ Women are affected due to their roles in home and vulnerability on unlit streets etc.	Benefits ▪ Reduced energy costs of lighting in business including as part of the production process. ▪ Reduction in crime against business due to improved street lighting ▪ Increased labor productivity due to improved working conditions.	Benefits ▪ Reduced cost of street lighting ▪ Reduced crime ▪ Reduced accidents
▪ Air conditioning	▪ Most as above apart from benefits of street lighting ▪ Benefits for women and vulnerable groups (elderly, disabled): More comfortable homes by being able to afford use more energy efficient AC	Costs Some businesses are likely to experience stranded assets, ie equipment which is no longer compliant with regulation and which they might need to take out of use.	• Increased productivity leads to increased tax intake Costs Stranded assets and increased demand for street lighting will lead to costs of investment)
	▪ Long term climate benefits		
▪ Energy quality	▪ Reduced costs due to less need to purchase replacement goods (women likely to benefit due to their use of white goods) ▪ Improved confidence in purchase of energy related products incl in domestic production	▪ Reduced costs due to less need to purchase replacement goods (capital goods) ▪ Improved confidence in purchase of energy related products incl in domestic production for the production process. ▪ Improved export opportunities	▪ Reduced costs due to less need to replace goods such as streetlights, equipment in Government Offices, rail stock, etc ▪ Increased tax base due to positive effects on business.
▪ Air quality	▪ Health benefits (reduced incidents of asthma and other respiratory problems) – particularly for vulnerable groups incl children and elderly with underlying health issues – health benefits expressed in reduced morbidity and mortality (incl ability to earn income) ▪ Impact on cleanliness of windows, houses has positive impact on well-being Costs	▪ Increased productivity of workers due to reduced illness caused by air pollution Costs Stranded assets (eg cars) should regulation prohibit the continued use of equipment	▪ Reduction in costs of treatment of ill health ▪ Increased tax intake due to positive impact on business and labour force Costs Stranded assets (eg cars) should regulation prohibit the continued use of equipment

	Consumers	Business	Government
	Stranded assets (eg cars) should regulation prohibit the continued use of equipment		
	▪ Benefits for the natural environment		

1.6. Sensitivity Analysis

Conducting sensitivity analysis is good practice in CBA. In doing that it is possible to test the role assumptions play in determining the final results.

1.6.1. Energy Efficiency: lighting:

The main assumption which leads made is that the OAS intervention leads to organizational change cause by learning (see Kirkpatrick method) and to the commitment by Governments to make changes to market regulation.

To test this assumption, it is possible to assume that the link between learning and organizational change breaks down in some of the participating countries. In SA1 it is assumed that El Salvador does not change the regulations. In SA2 that El Salvador and Nicaragua do not change. These countries have been selected purely randomly and this is not a statement about their commitment. Another important assumption is that household adopt the new light bulbs. In the calculations presented above it was assumed that this adoption would take 5 years. The third sensitivity (SA3) proposed here is that this period is longer, ie 10 years in total.

Table 17 summarizes the results of these. The third column shows the ROI assuming that nothing else has changed, ie including the other benefits included in Table 16

Table 17. Sensitivity analysis - energy efficiency lighting

	Remaining benefits from energy efficient lighting of households $m	Resulting ROI (if no other change occurs)
SA1: El Salvador does not succeed	$86.20	51.2
SA2: El Salvador and Nicaragua not succeeding	$77.80	47.60
SA3: Delay by 5 years	$72.10	45.15

1.6.2. Carbon emissions

Applying a similar methodology to the benefits derived from carbon emissions demonstrates the impact on benefits if some of the larger countries do not implement the energy efficiency measures.

If El Salvador or Nicaragua do not reduce their emissions, the difference in terms of value of Carbon reduction is hardly noticeable. However, if a larger country like Brazil drops out of the calculated benefits then the impact is felt more strongly. Table summarizes the results of this calculations.

Table 18. Sensitivity Analysis: Reduction in Carbon Emissions

Sensitivity	Remaining benefits from carbon reduction $m	Resulting ROI (if no other change occurs)
SA4: El Salvador does not succeed	$27.80	57.56

SA5: El Salvador and Nicaragua not succeeding	$27.50	57.41
SA6: El Salvador, Nicaragua and Brazil not succeeding	$16.70	52.77

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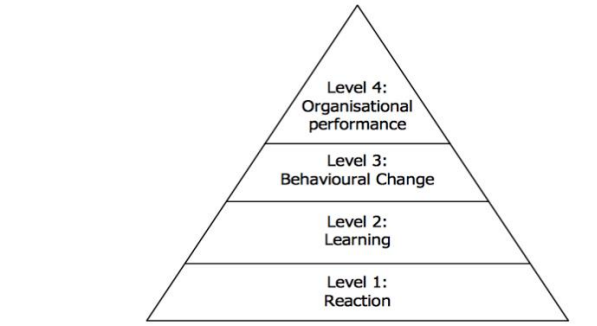
2. Annex to Cost Benefit Analysis

a) Methodology note

Assumptions

i) Commitment to change

The Cost Benefit Analysis makes assumptions regarding the degree of commitment to change in the participating States. The evaluation uses the Kirkpatrick method to identify whether interventions such as training had the desired impacted of behavioral change and organizational performance, as demonstrated in the Impact Evaluation of the Metrology Program for Sustainable Energy Technologies and the Environment (M4SET) Scientific exchange to strengthen services associated to the Quality of Energy.



Source: OAS, Impact Evaluation, Metrology Program for Sustainable Energy Technologies and the Environment (M4SET) Scientific exchange to strengthen services associated to the Quality of Energy

Follow up reports such as for the participant from Ecuador identify the knowledge and future application in Ecuador. This imply that organizational change is likely to occur. (Source: https://documentcloud.adobe.com/link/review?uri=urn:aaid:scds:US:92904359-9faa-4af4-8d75-692256d6bcad#pageNum=1)

ii) Impact of air pollution on labor productivity

Table 19 includes the assumptions made in the CBA

Table 19. Assumptions of the impact of air pollution on productivity

	lower	medium	upper
Share of workers affected by AQ morbidity	30%	50%	80%
Share of workers whose health and productivity improves.	10%	30%	50%
Share by which productivity improves	0.50%	1%	2%

The monetized figures used in the report reflect the lower boundary.

b) Consumer benefits from LED

Table 20. SICA 7 comparison of benefits between two calculation methods

Country	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua	Panama	Dominican Republic
Household benefit in PV over 10 years (generic saving figures) incl 5-year lag	1.4	1.8	4.7	2.7	1.9	1.2	3
Household benefit in PV over 10 years (country spec saving figures) incl 5-year lag	7.6	14.9	38.5	14.5	8.4	7.1	10.1
Ratio	5.43	8.28	8.19	5.37	4.42	5.92	3.37

This shows that the method using country specific data for the benefit monetization leads to between 3 and 8 times as benefits as the generic data. This demonstrates that the cautious approach to measurement where precise data is missing is underestimating the benefits and errs of the side of caution.

Table 21. Estimated energy efficiency benefits, countries with no specific data in US$m

Country In US$m	Argentina	Barbados	Belize	Brazil	Colombia	Ecuador	Jamaica	Mexico	Peru	St Lucia	Trin & Tob	Uruguay	Total
Household benefits	12.61	0.08	0.11	59.23	14.13	4.88	0.83	35.81	9.12	0.05	0.39	0.97	138.21

Note: Benefits are presented in present value over 10 years (country spec saving figures) including a 5-year lag, using the generic discount rate of 3.5%

Data:

- National data sources or UN data depending on availability (eg https://population.un.org/wpp/Download/Standard/Population/)
- Data on use of electrical goods
- Population and Health: IBRD data: Nutrition and population statistics https://databank.worldbank.org/source/health-nutrition-and-population-statistics
- Other data sources are being researched
- IBRD data eg. http://wdi.worldbank.org/table/5.1 on numbers of new businesses
- Employment and wage data: https://www.ilo.org/shinyapps/bulkexplorer44/?lang=en&segment=&id=EAP_2EAP_SEX_AGE_GEO_NB_A

  https://www.ilo.org/shinyapps/bulkexplorer6/?lang=en&segment=&id=EAR_4MMN_CUR_NB_A

Add further data sources are available in the Excel spreadsheet.