



UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION



# PHILIPPINE INDUSTRIAL ENERGY EFFICIENCY PROJECT (PIEEP)

## PROJECT TERMINAL REPORT

UNITED NATIONS INDUSTRIAL  
DEVELOPMENT ORGANIZATION

**Oscarlito Malvar, National Project Coordinator**



# ABOUT PIEEP

The Philippine Industrial Energy Efficiency Project (PIEEP) was a three-pronged program implemented by the United Nations Industrial Development Organization (UNIDO) which aimed to promote sustainable energy management system and achieved energy efficiency best practices within the Philippine industrial setting, with the purpose of achieving energy savings and contributing to climate change mitigation efforts.

This objective was achieved through the introduction of an energy management system (EnMS) compliant with the ISO 50001 standard; systems optimization (SO) approach for steam, compressed air and pump; and enhanced financial opportunities for energy efficiency investments.

The Global Environment Facility (GEF) provided a grant of \$3.166 million for the 5-year project period.

# PROJECT STEERING COMMITTEE

DEPARTMENT OF ENERGY



DEPARTMENT OF TRADE AND INDUSTRY – BUREAU OF PHILIPPINE STANDARDS



DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES



PHILIPPINE COUNCIL FOR INDUSTRY, ENERGY AND EMERGING TECHNOLOGY RESEARCH AND DEVELOPMENT



## THREE COMPONENTS OF PIEEP

### Energy Management System compliant with ISO 50001 Standard



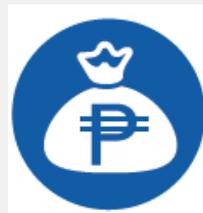
- Policy support
- Training materials and tools developed
- National awareness campaign to promote industrial energy management
- Peer-to-peer network developed between industrial enterprises
- Trained national experts and factory personnel on energy management
- Energy management implemented at participating industries
- Recognition program developed

### Energy Systems Optimization



- Training materials and tools developed
- Trained national experts/factory personnel on systems optimization
- Vendors (equipment suppliers) trained
- Documented system optimization demonstrated projects

### Enhancement of financing capacity



- Harmonized energy efficiency project evaluation criteria
- Training materials developed
- Managers trained on financial aspects of energy efficiency projects
- Support for packaging of loans for industrial energy efficiency projects

# **PROJECT TERMINAL REPORT**

UNIDO Project No.: GF/PHI/11/02

UNIDO SAP ID: 103049/200000288

GEF ID: 3601

**PROJECT MANAGEMENT UNIT**  
(01 JANUARY 2012 – 31 MARCH 2019)

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## List of Abbreviations

BAU	Business As Usual
BPS	Bureau of Philippine Standards
CC	Climate Change
CEO	Chief Executive Officer
CO2	Carbon Dioxide
DENR	Department of Environment and Natural Resources
DOE	Department of Energy
DOST	Department of Science and Technology
DTI	Department of Trade and Industry
EAP	East Asia and Pacific
EE	Energy Efficiency
EE&C	Energy Efficiency and Conservation
EnMS	Energy Management System
ERA	Energy Reform Agenda
ESCO	Energy Service Company
FSP	Full Size Project
GDP	Gross Domestic Product
GEF	Global Environment Facility
GG	Giga Gram
GHG	Greenhouse Gas
GJ	Giga Joules
HQ	Headquarters
IIEC	International Institute for Energy Conservation
ILO	Industry Liaison Officer
ISO	International Organization for Standardization
MTOE	Million Tons Of Oil Equivalent
MWH	Megawatt hour
NEECP	National Energy Efficiency and Conservation Program
NPC	National Project Coordinator
OIC	Officer In Charge
OJT	On the Job Training
PCIERD	Philippine Council for Industry, Energy and Emerging Technology Research & Development
PDCA	Plan Do Check Act
PDP	Philippine Development Plan
PEP	Philippine Energy Plan
PIEEP	Philippine Industrial Energy Efficiency Project
PMU	Project Management Unit
PPG	Project Preparation Grant
PSC	Project Steering Committee
Q&A	Question and Answer
SO	Systems Optimization
TPES	Total Primary Energy Supply
UNIDO	United Nations Industrial Development Organization

## Chapter 1. Project Management

This chapter presents the project details, rationale, components and activities. It further discusses the project design, grant and co-financing, equipment and assets, management structure as well as the achievements based on the expected outcomes.

### 1.1 Project Details

**Table 1. Project summary sheet**

<b>Project Title</b>	<b>Philippine Industrial Energy Efficiency Project (PIEEP)</b>
<b>GEF ID Number</b>	3601
<b>UNIDO ID (SAP Number)</b>	GF/PHI/11/002 (SAP: 200000288)
<b>Region</b>	EAP
<b>Country</b>	<b>Philippines</b>
<b>GEF Focal Area and Operational Program:</b>	CC (CCM), GEF-4
<b>GEF Agencies (Implementing Agency)</b>	UNIDO
<b>Project Executing Partners</b>	Department of Energy; Department of Trade and Industry
<b>Project Size (FSP, MSP, EA)</b>	FSP
<b>Project CEO Endorsement/Approval Date</b>	25-03-2011
<b>Project Implementation Start Date (PAD Issuance Date)</b>	16-04-2011
<b>Original Expected Implementation End Date (indicated in CEO Endorsement/Approval document)</b>	30-11-2016
<b>Revised Expected Implementation End Date (if any)</b>	31-12-2018
<b>GEF Grant (USD)</b>	USD 3,166,065
<b>GEF PPG (USD) (if any)</b>	USD 85,650
<b>Co-financing (USD) at CEO Endorsement</b>	USD 24,000,000
<b>Total Project Cost (USD) (GEF Grant + Co-financing at CEO Endorsement, excl. PPG)</b>	USD 27,166,065
<b>Agency Fee (USD, excl. PPG)</b>	USD 226,038

### 1.2 Project Rationale

The Philippines (Figure 1); an archipelagic country composed of 7,641 islands that lies in the western Pacific Ocean is endowed with abundant but underdeveloped indigenous energy resources. The country is dependent on fossil fuel imports and is very susceptible to volatile world oil prices. Net energy imports in 2011 accounted for 40% of the total energy supply comprised of 73.3% oil and oil products; 26% coal and 0.8% biofuels. The 2012-2030 Philippine Energy Plan, anchored on the policy framework set in place with the formulation of the Energy Reform Agenda, has outlined the following major pillars as its overall guidepost and direction: (a) Ensure energy security through

the development of indigenous energy such as renewable energy and hydrocarbon fuels (oil, gas and coal); (b) Achieve optimal energy pricing in electricity and oil; and (c) Develop a sustainable energy system through the formulation and update of national plans and programs on energy development, consistent with the country's economic development plans.



**Figure 1. Map of Philippines**

The average annual growth rate of the country's real GDP from 2001 to 2011 is 4.8%, with industry and services, both energy-intensive sectors, as main drivers of economic growth. For the past ten years, energy consumption in industry and services sectors increased, on the average, by 2.8% and 1.1%, respectively. As the country's economic performance is projected to grow, real GDP is forecasted to increase by 7.5% in 2012, 6.5% in 2013, 6.7% in 2014, and 7.5% from 2015 to 2016. Further, economic managers have forecasted the country's GDP to grow by as much as 8.4% from 2017-2020, and by 7.3% from 2021 to 2030.

The country's total primary energy supply (TPES) under the BAU scenario will grow at an annual average rate of 3.4% to reach 73.9 Mtoe by 2030, from 39.4 Mtoe in 2011. Primary oil supply is projected to grow by 2.1% per year under the BAU scenario from 12.4 Mtoe in 2011 to 18.3 Mtoe in 2030. Coal supply will increase at a faster rate of 7.2% while natural gas is projected to increase by 4.9% annually to meet increasing energy demand requirements. Energy use in the industry sector will grow rapidly at 5.1% annually, spurred by the projected increase in the activities of the manufacturing sector. The energy requirements of the commercial sector combined with trade and services will expand by 2.7% on the average. Natural gas (32%), geothermal energy (17%), and hydropower (14%) were the main domestic primary energy sources while oil and coal combined for the remaining 37% energy source.

Electricity contributes an average of 22.9% share to the final energy demand and is projected to grow by an average of 3.8% annually. The industry sector expand the fastest in terms of its energy demand at an annual average rate of 5.1% and an average share of 33.7% in the country's total final energy demand for the next 20 years. This translates to a demand level going up from 5.9 Mtoe in 2011 to 15.3 Mtoe in 2030. The commercial sector's energy requirement, on the other hand, will increase by a staggering

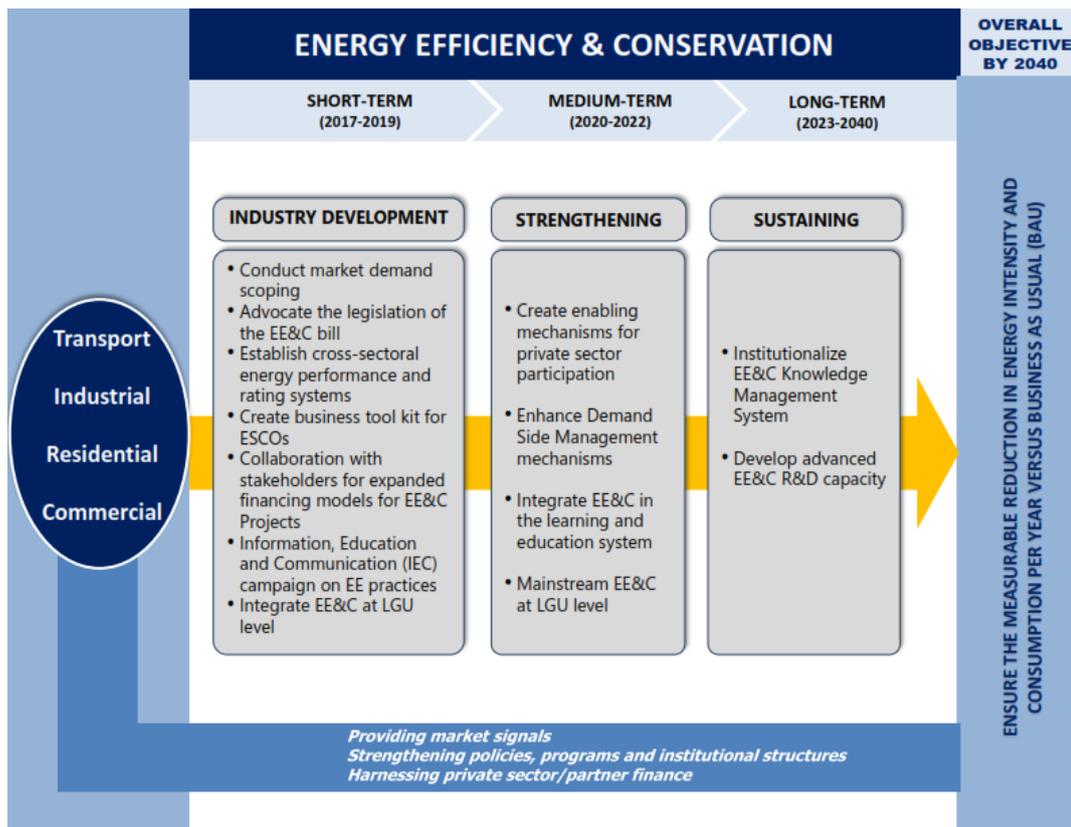
69.9%, from 2.6 Mtoe in 2011 to 4.6 Mtoe in 2030, growing at an annual average rate of 2.7%. Most of the growth in electricity demand is expected to be met by imported coal and oil.

Given the projected total energy demand under the BAU scenario, total GHG emission from fossil fuels (oil, coal and natural gas) is foreseen to increase at 4.5% per year from 72.9 MtCO<sub>2</sub>e in 2011 to 168.2 MtCO<sub>2</sub>e by 2030. Transport will account for the biggest share at an annual average of 24.7% followed by industry at 16.4%, and 6.8% from the combined share of commercial, residential and agriculture sectors.

To keep pace with the economic development, the Philippine government has drawn up plans and programs based on the principle that energy must be adequate, reliable and affordable to industries to enable them to provide continuous employment and low-cost goods and services. To provide adequate and reliable source of electricity and at the same time address the issue of climate change, the most effective solution over the short term is to increase the use of indigenous renewable energy and promote energy efficiency.

In 2004, the Department of Energy launched the National Energy Efficiency and Conservation Program (NEECP), aimed at improving energy utilization through energy efficiency and conservation at the same time avoid 5,086 Gg CO<sub>2</sub> emissions. It is a two-pronged program geared towards fuel efficiency and conservation and electricity efficiency and conservation by means of the following strategies: (1) the aggressive promotion of energy conservation and energy efficient technology to effect higher energy savings both for the consumer and producer through information, education and communication campaigns; (2) intensify collaboration effort with the private sector in implementing energy efficiency programs through voluntary agreements; (3) continuous implementation and expansion of the appliance and equipment energy standards and labeling implementation of building energy usage standards; (4) integration of energy efficiency concepts in the procurement practices of the government; (5) the provision of technical assistance in identifying, implementing and evaluating effective measures to improve energy use efficiency; (6) the use of alternative fuel to reduce dependence on imported oil; and (7) periodic program monitoring and evaluation to assess the effectiveness of the energy efficiency and conservation plan. However, the program is voluntary, thus resulting to very slow uptake and achievement of results.

In 2008, Republic Act No. 9513 was issued to accelerate the exploration and development of renewable energy resources such as biomass, solar, wind, hydro, geothermal and ocean energy, providing a legal framework to increase the utilization of these energy resources. However, up to the present, the law pertaining to energy efficiency and conservation is still being deliberated by Philippine Congress. Recently, DOE issued an updated EE&C guide to further strengthen energy efficiency efforts for the private and public sectors alike in the Philippines. Figure 2 shows the roadmap which extends the energy efficiency and conservation program of DOE until 2040.



**Figure 2. Energy Efficiency and Conservation Roadmap**

Industry's energy demand is one of the most intensive among the sectors of the country's economy. However, energy efficiency achievements in Philippine industry can be largely attributed to industry's own efforts during periods of high energy prices. In addition, these barriers further prevent the industry from adopting energy efficiency practices: (1) Lack of information on energy management services market; (2) Lack of market interest in energy efficiency; (3) Slow penetration of energy efficiency know-how and technologies; (4) Unsustainable culture of efficiency in energy utilization; and (5) Opportunities and challenges of a restructured electric industry. Consequently, efforts to improve energy efficiency have not been consistent and do not enjoy continuous attention from senior industry managers.

The Philippine Industrial Energy Efficiency Project (PIEEP) was proposed to complement the government's energy efficiency and conservation program and to further elevate the benefits of energy efficiency to the industrial sector. The project collaboration between UNIDO and DOE together with the DTI is composed of three (3) components: (1) Energy Management System based on ISO 50001 Standard; (2) Systems Optimization Approach for steam, compressed air and pump; and (3) Enhancing the financing capacity of energy efficiency projects.

The project will promote industrial energy efficiency through the introduction of a sustainable energy management system based on an international standard together with industrial energy systems optimization approach. Capacity building of stakeholders

such as enterprises, equipment suppliers, engineering/energy service companies and government planners in implementing system level efficiency improvements and integration of energy efficiency into management systems of industrial enterprises will institutionalize energy management and allow a comprehensive and integrated approach that ensures sustainable energy cost reduction and improves the facility productivity in a continuous manner. Moreover, enhancement of financing opportunities by providing capacity building to financial institutions in assessing and evaluating energy efficiency projects lead to better understanding of viable business opportunities that can be generated in these types of project. It will also help standardize and streamline evaluation criteria applied by local banks when evaluating applications for financing from industrial facilities seeking assistance for energy efficiency improvement projects.

### 1.3 Project Design

PIEEP was endorsed in late March 2011 and was supposed to start its implementation the following month. However, setting up the Project Management Unit to oversee the project's implementation was completed by the end of the year. PIEEP formally started early January 2012 as a Full Sized Project, which was initially operate until November 30, 2016. Revision was made to implement the project until May 31, 2017, but was further extended until December 30, 2018 due to the request of the partner executing agency in the Philippines, the Department of Energy. In the end, the project officially terminated on March 31, 2019.

UNIDO as the technical implementing partner was joined by the following Philippine agencies, which also composed the Steering Committee:

1. Department of Energy (DOE)
2. Department of Trade and Industry – Bureau of Philippine Standards (DTI-BPS)
3. Department of Environment and Natural Resources (DENR)
4. Department of Science and Technology – Philippine Council for Industry, Energy and Emerging Technology Research and Development (DOST-PCIERD)

The main objective of the project is to introduce an energy management system based on ISO 50001 Standard together with system optimization approach for steam, pump and compressed air systems to improve industrial energy efficiency of Philippine companies.

The project's systems optimization approach and energy management standard are applicable to all industries but initially targeted the 4 sectors listed below:

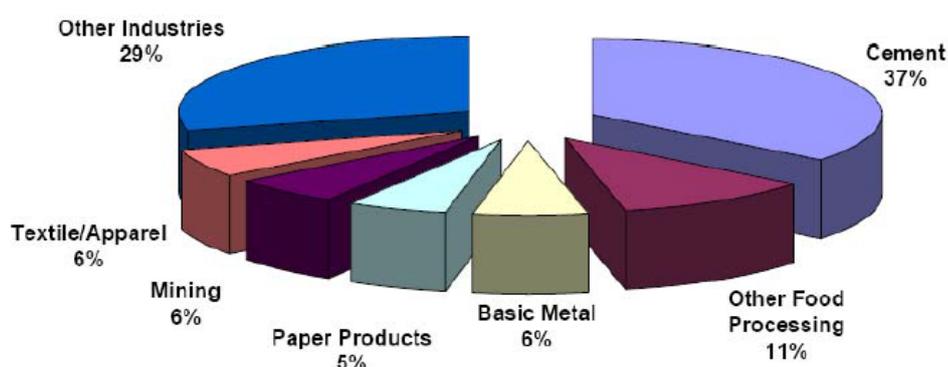
1. Food and Beverages
2. Basic Metals and Steel
3. Chemicals
4. Paper and Paper Products

The sectors were selected based on a survey conducted by UNIDO to define the energy efficiency and energy management baseline on Philippine industries at the time

of project preparation. The target industries, identified during implementation of the PPG, were prioritized based on the following criteria:

- impact on national GHG emission mitigation
- capacity to respond to energy management opportunities
- replicability - sufficient number of industrial facilities
- importance to the Philippine economy

These criteria were assigned weights based on the project’s goal of achieving industrial energy efficiency through energy systems optimization and energy management standard. Most important among the criteria is the industries’ impact on GHG emission mitigation, which will consider factors such as energy intensity, the type of fuel mix, the facility size and the percentage contribution to total GHG emissions. Figure 3 shows the CO2 emissions from fuel combustion of the manufacturing industry at the time of UNIDO’s survey.



**Figure 3. CO2 Emissions from Fuel Combustion in the Manufacturing Industries**

The second criteria is the capacity of the industry to respond to energy management opportunities looking into participation in export markets, experience with ISO 9001 or 14001 and having access to capital for funding energy efficiency projects. Table 2 shows the capacity of Philippine industries to respond to energy management opportunities.

**Table 2. Capacity to Respond to Energy Management Opportunity**

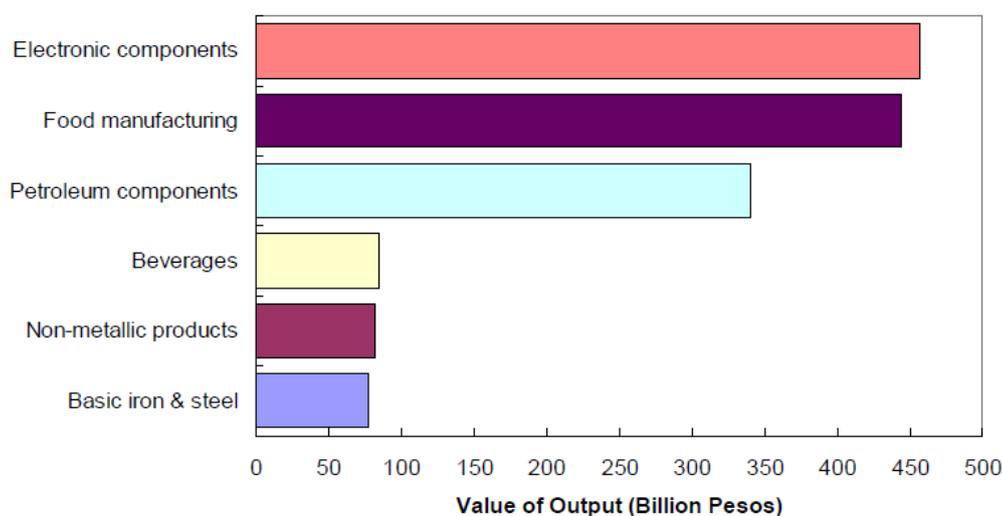
Industries	Participation in Export Markets	ISO Certified	Access to Capital	Weight Percentage
Food & Beverages	High	High	High	30%
Basic Metals (Steel)	High	High	Medium	28%
Chemicals	High	High	Medium	28%
Textiles/Wearing Apparel	High	High	Medium	28%
Paper & Paper Products	Medium	High	High	28%
Ceramics	Medium	High	Medium	26%
Rubber & Plastic Products	Medium	High	Medium	26%
Sugar	Medium	High	Medium	26%

The third criteria dealt with how the industrial sector is structured – whether it consists of a considerable number of industries where energy efficiency projects can be replicated. Table 3 below shows the replication factor of the selected industrial sub-sectors.

**Table 3. Replication Factor**

Industries	Weight Percentage
Food & Beverages	20%
Textiles/Wearing Apparel	18%
Basic Metals (Steel)	18%
Rubber & Plastic Products	16%
Chemicals	16%
Ceramics	14%
Paper & Paper Products	14%
Sugar	14%

Finally, industries were assessed based on their contribution to the national economy. Figure 4 shows the top grossers in value output in the same UNIDO survey conducted prior to project implementation.



**Figure 4. Top Grossers in Value Output for Philippine Manufacturing Establishments**

The target groups of the project are industrial enterprises (both decision makers and technical personnel), equipment vendors, energy professionals, ESCOs and government agencies and promote industrial EE through systems optimization approach and ISO energy management standard. The synergies of the project components will ensure that the design will bring about the expected energy savings for the targeted industries and more importantly, the corresponding GHG emission reductions that will be realized resulting from energy management system and systems optimization approach adopted by industrial enterprises. Table 4 presents the project component together with the expected outputs and outcomes

**Table 4. Project Components and Expected Outcomes**

Project Component	Expected Outputs	Expected Outcomes
<b>1. Energy Management System</b>	<b>Output 1.1</b> Policy support <b>Output 1.2</b> Training materials and tools developed <b>Output 1.3.</b> National awareness campaign to promote industrial energy management. <b>Output 1.4.</b> A peer-to-peer network developed between industrial enterprises. <b>Output 1.5.</b> Trained national experts and factory personnel on energy management. <b>Output 1.6</b> Energy management implemented at participating industries <b>Output 1.7</b> Recognition program developed	Energy management standard promulgated nationally.  Capacity of industry and industry support organizations developed to implement ISO compliant energy management systems.  Increased adoption of energy management standards by industry
<b>2. System Optimization</b>	<b>Output 2.1.</b> Training materials and tools developed <b>Output 2.2</b> Trained national experts/factory personnel on system optimization <b>Output 2.3</b> Vendors (equipment suppliers) trained <b>Output 2.4</b> Documented system optimization demonstration projects.	Capacity of industry and industry support organizations developed to implement systems optimization.  Increased adoption of system optimization energy efficiency projects by industry
<b>3. Enhancement of financing capacity</b>	<b>Output 3.1</b> Harmonized energy efficiency project evaluation criteria <b>Output 3.2</b> Training materials developed <b>Output 3.3</b> Managers trained on financial aspects of energy efficiency projects. <b>Output 3.4</b> Support for packaging of loans for industrial energy efficiency projects	Increased availability of financial capacity and support for industrial energy efficiency projects

In 2015, during the 5<sup>th</sup> Project Steering Committee (PSC) meeting, PMU proposed additional focus sectors to be included in the project, namely: (i) cement; (ii) semiconductors and microelectronics; and (iii) water utilities. It was subsequently approved by the PSC due to the changing economic situation of the country aside from meeting the selection criteria mentioned above. The additional three sectors were energy intensive and huge consumers of steam/heat, compressed air and pump systems respectively. It made sense to include these sectors as it complemented the systems optimization approach component of the project plus the added bonus of conserving water resources in the case of the water utility sector.

## 1.4 Project Activities

### Component 1: Energy Management System compliant with ISO 50001

For this component, the activities will strengthen the capacity of policymakers to introduce an energy management system based on an international standard. Training materials and tools on energy management will be developed that will allow industrial facilities to understand the importance of energy management standard and undertake energy management planning. Energy performance reporting structure will be developed to help industries track improvement when implementing the system based on the standard. A national awareness campaign will be organized urging industries and key stakeholders to shift from current operations to energy efficient practices aligned with the ISO 50001 framework. The campaign will use promotional literature such as brochures, flyers and other printed materials as well as press releases to be generated by joining energy conferences and related energy fora organized by industry associations. In addition, a peer-to-peer network will be established managed by the PMU to facilitate information exchange between the participating industries. Facilities which will take part in the project will be encouraged to send their energy management implementation plan and the result of implementations. This exchange of information will stimulate industries by providing them with information on a range of energy management and system optimization solution and their impact on the industry energy consumption.

Forty (40) individuals selected on the basis of agreed criteria with the DOE and DTI-BPS, will receive training in energy management from UNIDO International Experts. These individuals would subsequently assume roles as National Energy Management Experts, become a source of national energy management expertise and serve as multipliers for project impacts. They will be trained through a mentoring and on-the-job (OJT) process by UNIDO's international team to an intermediate level of expertise and be capable of:

- Conducting a 1/2 day awareness workshop for factory managers on the benefits of energy management and conformance with ISO 50001.
- Conducting a 2-day training session for energy managers on implementation of an energy management system in conformance with ISO 50001.
- Coaching facility personnel on energy management system implementation.

Candidates for energy management training will be drawn from the ranks of consultants, government officials, and factory personnel who are already skilled in the implementation of management systems such as ISO 9001 or 14001. A central requirement for successful energy management candidates will be the ability to work with factory managers to establish a management system.

Half-day workshops will introduce energy management to as many factory managers as possible (target 500) and a networking opportunity. The workshop purpose is to encourage managers to authorize their key staff to participate in the subsequent two-day implementation training session. This will be a high-level workshop that is presented in the language of management and speaks to issues such the role of ISO

50001 in improving competitiveness, meeting national climate change and energy efficiency mandates, and enhancing prospects for international trade.

The two-day training sessions are targeted to the person designated by management as responsible for implementing the management system. The two-day training will guide participants through the Plan-Do-Check-Act cycle as it applies to the ISO 50001 energy management standard. Instruction will be given on how to establish an effective energy policy, set improvement targets and objectives, establish energy performance indicators, identify significant energy uses and opportunities for improvement. Instruction will also be given on the value of conducting industrial system optimization assessments in order to identify early energy saving opportunities and build momentum for the energy management system. Participants in the two-day training session will be registered for the peer-to-peer network. Each participating factory will also have access to support from the national energy management experts to assist them in implementing their energy management system.

Forty (40) industrial facilities will also receive direct support through the project, enabling them to reach conformance level with ISO 50001. Support consists of extensive onsite support from the national energy management experts guided by technical support from the UNIDO International Energy Management experts.

Industries that send their staff to the two-day training and receive support from the national energy management experts will also be expected to implement operational improvement in energy management projects (totaling 200 projects). Reporting on progress will be made via the website created to support the peer-to-peer network.

### *Component 2: Energy Systems Optimization*

The training materials and tools that will be developed for this component will assist industrial facilities and consultants understand and apply the systems optimization approach applied to the following targeted industrial energy systems: pump, compressed air and steam.

Candidates that will be trained to become system optimization experts will require solid technical skills and specific expertise in the energy use of their chosen system or systems (compressed air, pump, or steam). A one-to-one, one-to-many training and implementation scheme will be implemented, in which UNIDO's team of international experts are engaged in initial capacity-building to create a core of 40 highly-skilled Filipino experts. Upon completion of initial system optimization training courses, the international teams return to work with their trainees on plant assessment and project development skills. In addition, the international teams prepare and observe trained national experts conducting training of local personnel in "factory training sessions".

To ensure success of this component, selection of trainees will be rigorous and based on technical and training capabilities. Upon completion of their training these individuals will be capable of:

- Conducting system assessments and preparing professional technical/financial reports.
- Delivering training on systems optimization to factory personnel.
- Delivering consulting services to factories to enable them to implement systems optimization projects.

Systems optimization training follows these steps:

1. Preparatory activities are completed over periods of 2 to 3 months in advance of each system optimization training course. This involves the compilation of training materials by international teams, the identification of appropriate factories for the in-plant training with requisite steam, compressed air, and pump systems, securing approval of site visits, purchase of measurement equipment (pressure, flow, power consumption, leak detection...) to perform the in-plant training, acquisition of technical data from host plants pertaining to the systems and components to be evaluated by the teams, identification of classroom facilities, provision of accommodation for trainees etc.

2. During system optimization training, the UNIDO international teams train 40 local energy experts in classroom and plant settings. At each plant the local experts are trained “on-the-job” in the use of measuring instrumentation, data collection and analysis and the preparation of investment proposals for energy systems improvements which are subsequently submitted to management of the plants hosting the training. Training covers system design, operation and installation, measurement of fluid flows, pressures, energy consumption, and application of analytical software.

Concurrent with experts training, the international team will conduct training to introduce equipment vendors, manufacturers’ representatives, and suppliers of steam boilers, pumps, and compressors to system optimization techniques. Each training session will be a mix of theory and practical considerations. The purpose of this training is to prepare manufacturers, vendors and suppliers to 1) participate in reinforcing the system optimization message with their customers and 2) assist them in identifying what will be required to reshape their market offerings to reflect a system services approach. It is expected that forty (40) participating industries will implement systems optimization projects in their facilities. Case studies will document the energy and greenhouse gas emissions savings directly attributable to the project.

Component 3: Enhancement of financing capacity

International and national finance experts will work with the national financial institutions and the government to develop a process for evaluating energy efficiency projects. The evaluation criteria will be designed to be applied by financial institutions when evaluating applications for financing from industrial facilities seeking assistance for energy efficiency improvement projects. These criteria will be:

- a. consistent with accepted banking practices
- b. will include a scoring system that will provide guidance for bankers in determining the validity of projected energy savings resulting from proposed energy efficiency improvements, and

- c. provide guidance on using the scoring system as an input to the assessment process to determine the return on investment for the financial institution from a loan for the proposed improvements

A series of two-day workshops will be organized with the goal of training bankers, financial analysts, industrialists and investment decision makers at large, on assessment of different issues related to industrial energy efficiency projects so that financial institutions will be in better position to offer attractive loan packages to the industries. The workshops will include: project development cycle, market analysis, technical aspects, financial analysis, economic cost-benefit analysis, and project implementation etc.

## 1.5 Project Management Structure

UNIDO will serve as the implementing agency for the project. The primary stakeholder is the Department of Energy (DOE), which is the designated national executing agency. DOE is the apex body within the Government of the Philippines mandated to implement national energy conservation policy. The Department of Trade and Industry, Bureau of Philippine Standards (DTI-BPS), will support the introduction of an energy management standard (ISO 50001). DOE provides synergy with other national and donor-supported energy efficiency initiatives in the country. DOE is advocating the passage of the Energy Efficiency and Conservation Law designed to promote energy efficiency across all economic sectors nationwide. The law would include policies, goals, directions regulations and guidelines for implementation of the National Energy Efficiency and Conservation Program (NEECP).

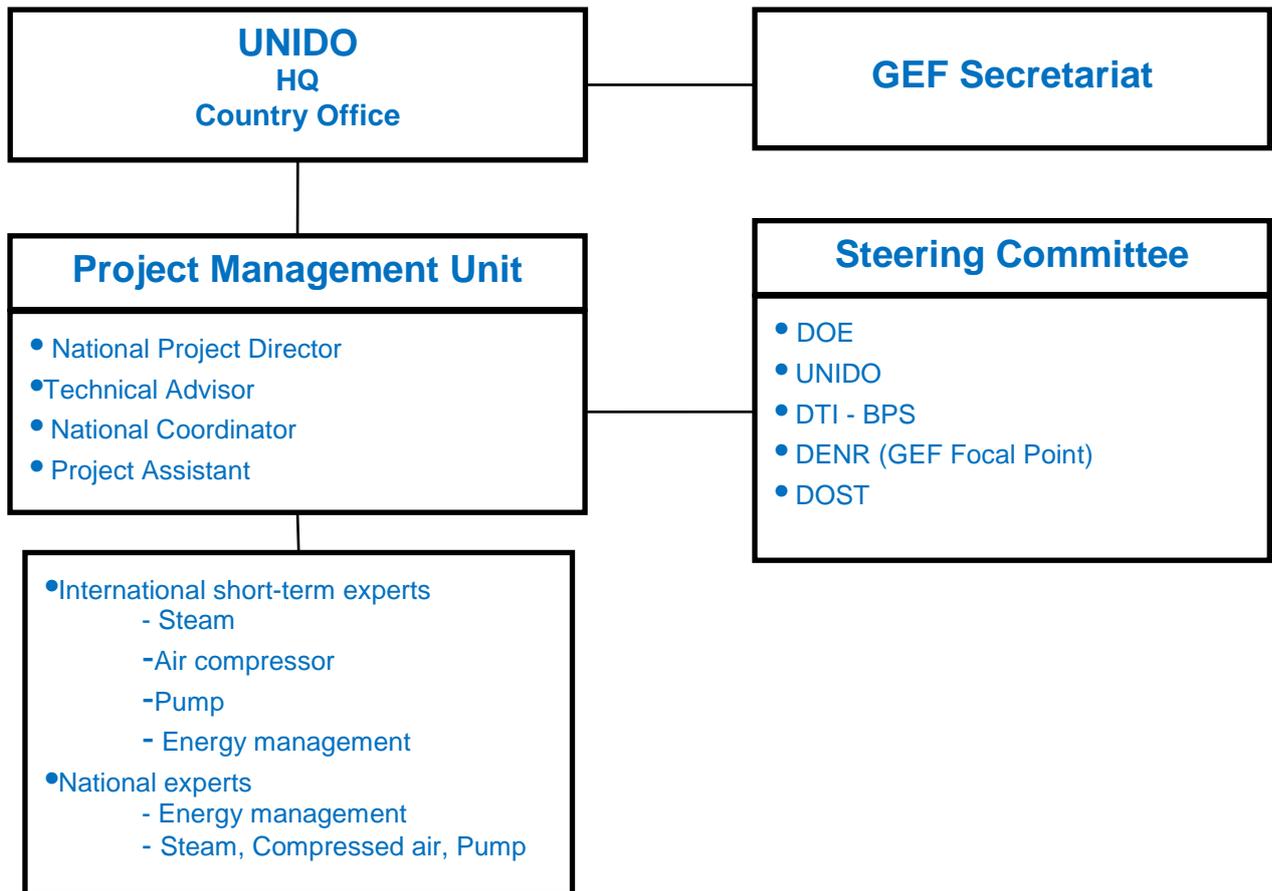
UNIDO HQ technical staff, supported by UNIDO Manila office will provide GEF oversight and financial management as well as strategic technical direction for the project. In particular, UNIDO will be responsible for selection and recruitment of international experts.

The project will establish a Steering Committee with representation of key stakeholders in the project specifically and more generally with expert knowledge on energy efficiency activities in the Philippines. The Committee will meet at least once per year to review and evaluate progress and will provide broad policy guidelines for implementation of the three project components.

DOE, DTI-BPS and UNIDO will establish a Project Management Unit to be responsible for overall day-to-day project operations and financial management and reporting for both the GEF and government including staffing, planning and implementation of the in-country activities, particularly organization of the training programs. UNIDO will provide the necessary technical inputs to inform the work of the PMU. Its work will be under the overall supervision of the National Project Director – a senior DOE official tasked with ensuring that project activities are consistent with promulgated government energy policy. Day to day management of the project office will be undertaken by the National Project Coordinator to be assisted by Project Management Staff. UNIDO, supported by international experts, will play a significant

role in providing technical guidance to project implementation including recruitment of international experts. The training responsibilities will be progressively transitioned to national experts that have completed the in-depth training on energy management and systems optimization.

UNIDO headquarters and country office will undertake GEF oversight and submit reports to GEF Secretariat as required. The project management structure is shown in Figure 5 below:



**Figure 5. Project Management Structure**

## 1.6 Grant and Co-Financing

The total grant amount provided by the GEF during the endorsement stage of the project was US\$ 3,166,065. Co-financing from the Philippine counterparts totaled US\$24 million in the form of cash, in-kind contribution, and loan.

Since the project design has changed in terms of components but the objective and expected outcomes remain in line with the original PIF, budget reallocation was also modified at the CEO endorsement stage. The project design differs from the original PIF in that demonstration projects (component 4 of the PIF) are incorporated into components 1 and 2 that will deliver capacity building on energy management and systems optimization removing component 4 in the final document. The outputs indicated

under component 4 have been moved to component 2. This justifies the increased amount under component 2 as it includes investments on system optimization projects. This will provide more coherence as all energy management related outputs are lumped together under Component 1. The changes in component-wise budget allocation are justified by the activities to be carried out in the new components and the shift of these activities from one component to another. The revised format leads to a more integrated and comprehensive approach to securing industry's commitment to the implementation of the demonstration projects.

The committed co-financing from the commercial banks is more than the required investments for the energy efficiency projects. Table 5 below shows the breakdown of the co-financing amounts from partner banks and Department of Energy.

**Table 5. Co-financing for the project**

Name of Co-financier (source)	Classification	Type	US\$	%*
Department of Energy	National Gov't Agency	Cash and in-kind	4,000,000	16.67%
Land Bank	Government owned bank	Loan	10,000,000	41.67%
Bank of Philippine Islands**	Private bank	Loan	10,000,000	41.67%
Development Bank of Philippines***	Government owned bank	Loan	-	-
<b>Total Co-financing</b>			<b>24,000,000</b>	<b>100%</b>

\* Percentage of each co-financier's contribution at CEO endorsement to total co-financing.

\*\* The co-financing contribution from the Bank of Philippine Islands does not include any contribution from the International Finance Corporation (IFC).

\*\*\* The Development Bank of Philippines has issued an open co-financing commitment without any ceiling. The co-financing for investment on energy efficiency projects has been secured more than expected requirements. Committed co-financing amounts from Land Bank and Bank of Philippines Islands are more than required for investments.

The letters of co-financing issued by the three (3) partner banks in support of the project can be found in **Annex A**.

## 1.7 Equipment and Assets

In order to establish baseline data for the different energy systems that the project aims to improve, energy audit equipment and tools were procured during its implementation. Specifically for component 2 of the project, optimization of steam, compressed air and pump systems require measurements to establish current energy performance of the industry sectors covered by the project. **Annex B** shows the complete list of equipment and assets acquired by the project. These assets and equipment will be turned over to the partner agency, Department of Energy, once the project wraps up in March 2019.

Figure 6 shows some of the energy audit equipment acquired by the project which was used during training of local experts and actual assessment of the industry sub-sectors.



**Figure 6. Data logger for compressed air (left), flow meter for pump (center), and combustion analyzer for steam (right)**

## 1.8 Project Achievements

The project was able to achieve its targets and expected outputs, mainly due to the strategic partnerships forged with conglomerates and institutional organizations. Furthermore, the continuous promotion and awareness-building on the importance of an ISO-compliant energy management system during capacity building activities of the project made the industries more keen to adopt EnMS, especially with the imminent passage of the energy efficiency and conservation bill into a law.

Table 6 presents a summary of selected targets and actual achievements of the project in terms of people trained, companies that implemented energy management and systems optimization, energy saved and corresponding carbon dioxide emissions reduced.

**Table 6. Summary of achievements under the project's three components**

Expected Outputs	Targets	Actual Achievement	Remarks
<b>Component 1: Energy management system (EnMS) compliant with ISO 50001</b>			
<b>1.5 Trained national experts/factory personnel on energy management</b>			
1.5.1 EnMS National Experts trained	40	44	
1.5.2 Factory managers and staff trained	500	1,992	586 (29%) are women
1.5.3 Factories trained for EnMS implementation	300	1,034	
<b>1.6 ISO-compliant energy management system implemented</b>			
1.6.1 Factories fully implementing EnMS	40	46	10 are ISO 50001 certified

Expected Outputs	Targets	Actual Achievement	Remarks
<b>Component 2: Systems Optimization (steam, compressed air and pump)</b>			
<b>2.2 Trained national experts/factory personnel on Systems Optimization</b>			
2.2.1 SO National Experts trained	40	90	44 are certified national experts
2.2.2 Factory managers and staff trained	400	1,172	
2.2.3 Factories trained on UNIDO tools	150	424	
<b>2.4 Documented Industry Demonstration Projects</b>			
2.4.2 Implemented SO projects	40	163	
<b>Component 3: Enhancing Financial Capacity for energy efficiency projects</b>			
<b>3.3 Managers trained in the financial aspects of energy efficiency projects</b>			
3.3.1 National experts trained	40	38	
3.3.2 Factory managers and staff trained	100	74	
3.3.3 Financial institution managers trained	50	52	financial managers from 22 financial institutions

With these achievements, the project was able to save **5,942,745 GJ** of fuel (or 1,188,549 GJ/y) and **464,445 MWh of electricity** (or 92,889 MWh/y) for the completed and on-going implementation of energy management system and systems optimization initiatives over a 5-year duration. These efforts corresponded to **1,073,695 tCO<sub>2</sub> emissions avoided** (or 213,739 tCO<sub>2</sub>/y) over the same period of implementation for both components of the project. In addition, the project was able to establish the reputation of its trained national experts for both EnMS and SO, as they are now tapped by Philippine industries as resource persons for training as well as consultants for setting up an energy management system and technical site assessments by the industry.

In terms of gender mainstreaming, which was not part of the original project design, a significant number of women factory personnel were trained under Component 1. There were also women national experts for both the energy management system and systems optimization components of the project.

## **Chapter 2. Energy Management System (EnMS) compliant with ISO 50001**

Chapter 2 describes the activities of the project's first component together with the expected outputs and outcomes. It also presents the challenges/experiences, and lessons learned in implementing this component of the project.

### **2.1 Policy Support**

The Department of Energy issued a memorandum circular in 1993 requiring all industrial, commercial and transport establishments in the Philippines consuming more than 1 million fuel oil equivalent liters of energy annually to submit quarterly reports to gather information and determine the applicable policy in setting up an energy monitoring program consistent with the government's vision of ensuring judicious conservation and efficient utilization of energy. The same circular requires companies consuming more than two million fuel oil equivalent liters annually are further encouraged to submit annual energy conservation reports. However, since the circular is a voluntary effort, it did not capture the actual consumption of the target energy consuming sectors and few enterprises submitted the reports.

In 2004, DOE issued Administrative Order No. 110 directing the institutionalization of a government energy management program (GEMP). The goal of GEMP is reduce the monthly consumption of electricity and petroleum products for a minimum period of three (3) years starting in 2005. The order is mandatory and applied to all national government agencies with a goal of reducing 10% fuel consumption as well as 10% of average monthly electricity consumption. Each government entity is required to conduct an energy audit and designate energy conservation officer responsible for doing the audit as well as compliance with the provisions of the order. Again, the mandatory program suffered a setback since not all national government agencies have the capability to perform an audit and rely on the DOE's assistance to comply with the order. However, the DOE can provide limited technical assistance due to limited manpower.

PIEEP supports DOE in expanding the awareness of the private sector on the memorandum circular as well as the administrative order to the public sector by including it in its capacity building activities on energy management system. PIEEP explains DOE's memorandum circular as well as the administrative order by encouraging the participants to submit their reports so that better understanding of the country's energy consumption by the government can lead to crafting a more responsive energy policy. Recently, PIEEP has been assisting the DOE in promoting the Guidelines on Philippine Energy Standards and Labeling Program (PESLP) for Energy-Consuming Products which apply to all importers, manufacturers, distributors and dealers of PESLP-covered energy-consuming products such as equipment, devices, as well as those institutionally manufactured or sold energy-consuming products. In addition, PIEEP also included DOE's expanded energy efficiency and conservation roadmap by presenting it during capacity building activities on energy management system.

## 2.2 Training Materials and Tools

There were three (3) sets of training materials developed for the energy management system component of PIEEP. The first set is designed for top management of enterprises or their representative with the main objective of introducing the energy management system and its benefits and encourage the top managers to participate in PIEEP by sending their key staff to the more technical 2-Day EnMS user training.

The two-day user training on energy management system caters to energy managers, facilities and maintenance supervisors and other significant energy personnel of enterprises. The training materials for this set will provide the skills and tools to enable the implementation of EnMS based on ISO 50001. The trainees will be guided through the Plan-Do-Check-Act cycle as it applies to the ISO 50001 energy management standard. Further, step-by-step instructions on how to establish an effective energy policy, review energy use, identify significant and opportunities for improvement, set objectives and targets, establishment of an energy baseline and creation of energy performance indicators will be taught to participants.

Lastly, training materials and tools for national experts on energy management system was developed with the paramount objective of enabling the trainees of not just learning the system but also build their capacity in providing technical assistance and training the enterprises on EnMS/ISO 50001 Standard. Of the three sets, the training materials in this set is more comprehensive and intensive which targeted EE consultants, ESCOs, ISO 14001 experts, energy managers of selected enterprises, system professionals and industry energy practitioners. To become a national expert, participants were trained through classroom, on-the-job and coaching by UNIDO international EnMS/ISO 50001 experts and equipped with the expertise and the tools required to:

1. Develop and implement energy management system in line with ISO 50001
2. Provide technical assistance to enterprises and coaching facility personnel for developing and implementing energy management system in line with ISO 50001
3. Conduct Half-day Awareness workshops
4. Conduct Two-day USER training

## 2.3 National Awareness Campaign

PIEEP produced publicity materials e.g. brochures, flyers to create national awareness about the project components and objectives. Three sets of brochures were produced, one for energy management system, one for systems optimization and another one for the overall project description and activities. In addition, an infographic material pertaining to the benefits of energy management system was produced aside from the flyers and banners produced during capacity building activities for the half day, two day and experts' training. Two national forums were organized, one in Luzon and another for the Visayas-Mindanao region, in 2015 and 2016 respectively. PIEEP also

joined relevant events such as energy efficiency workshops and conferences organized by the Department of Energy, European Chamber of Commerce in the Philippines as well as numerous conventions by industry associations. Promotional booths about the project were set up in Expos and energy related gatherings. Table 7 shows the summary of workshops organized by the project while **Annex C** shows the brochures produced by PIEEP.

**Table 7. Summary of Workshops Organized by the Project**

Title of Workshop	Venue/Date	Remarks
Project Inception Workshop	Manila/March 23, 2012	Organizer
National Awareness Workshop	Manila/July 3, 2012	Organizer
National Awareness Workshop	Cebu/March 11, 2013	Organizer
National Awareness Workshop	Pampanga/March 20, 2013	Organizer
National Awareness Workshop	Manila/May 20, 2013	Organizer
National Awareness Workshop	Davao/December 3, 2013	Organizer
Awareness Workshop with Federation of Philippine Industries	Manila/February 19, 2014	Organizer
Policy Workshop with DOE	Manila/February 20, 2014	Organizer
Awareness Workshop with Executives of Private Sector	Tagaytay/July 2, 2014	Organizer
Half-Day Awareness Workshop	Manila/August 20, 2014	Organizer
Half-Day Awareness Workshop	Manila/April 22, 2015	Organizer
Half-Day Awareness Workshop	Manila/September 23, 2015	Organizer
Half-Day Awareness Workshop	Cebu/January 14, 2016	Organizer
Half-Day Awareness Workshop	Manila/February 4, 2016	Organizer
Half-Day Awareness Workshop	Cagayan De Oro/February 18, 2016	Organizer
Half-Day Awareness Workshop	Davao/March 9, 2016	Organizer
Half-Day Awareness Workshop	Laguna/July 28, 2016	Co-organizer w/PEZA*
Half-Day Awareness Workshop	Laguna/August 31, 2016	Co-organizer w/PEZA*
Half-Day Awareness Workshop	Batangas/September 29, 2016	Co-organizer w/PEZA*
Half-Day Awareness Workshop	Manila/January 16, 2017	Co-organizer w/ Quezon City
Half-Day Awareness Workshop	Baguio/May 24, 2017	Co-organizer w/PEZA*
Half-Day Awareness Workshop	Manila/July 25, 2017	Co-organizer w/ Quezon City
Half-Day Awareness Workshop	Manila/July 26, 2017	Co-organizer w/ Quezon City
Half-Day Awareness Workshop	Manila/July 28, 2017	Co-organizer w/ Quezon City
Half-Day Awareness Workshop	Laguna/September 26, 2017	Co-organizer w/PEZA*
Half-Day Awareness Workshop	Manila/September 27, 2017	Co-organizer with League of Cities of the Philippines (LCP)
Half-Day Awareness Workshop	Cebu/February 18, 2018	Co-organizer with PEZA*

\*PEZA – Philippine Economic Zone Authority

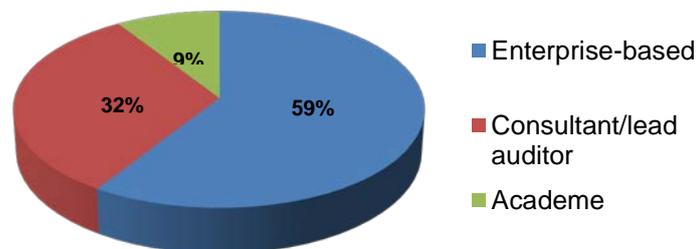
## 2.4 Peer-to-Peer Network

A network was created and managed by the PMU using the Basecamp platform to facilitate information exchange between the participating industries and national experts. The exchange of information between industries and national experts provided an

avenue to exchange information on a range of energy management and systems optimization solutions and their impact on the industry's energy consumption. Later on, subscription to the Basecamp platform was abandoned and the national experts and participating industries used the free Facebook group application still facilitated by the PMU.

## 2.5 Trained National Experts/Factory Personnel on Energy Management

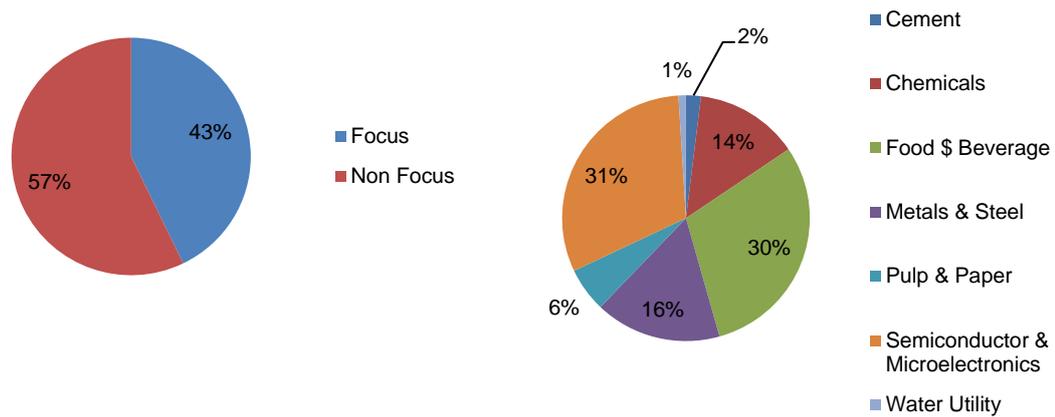
A total of forty four (44) national experts on energy management system finished the training program meeting the targeted 40 local experts for the project. Two (2) batches of training were held for national experts. The first batch was composed of thirty (30) trainees out of which nineteen (19) were able to complete the training. In the second batch of trainees, thirty two (32) persons joined the training but only twenty five (25) was able to finish the program. Of the 44 national experts, 59% were factory-based while the remainder is divided into 32% consultants/certification bodies-affiliated and 9% academe. Factory-based national experts were composed of engineering supervisors in charge of maintenance, facility management, production and operations. National experts from consultancy were employed by a consultancy firm, some are sole proprietors and others are freelancers while certification bodies-affiliated national experts were mostly lead auditors for management systems like 9001 and/or 14001. National experts from the academe were composed of deans and professors of engineering colleges. Figure 7 shows the breakdown of energy management system national experts.



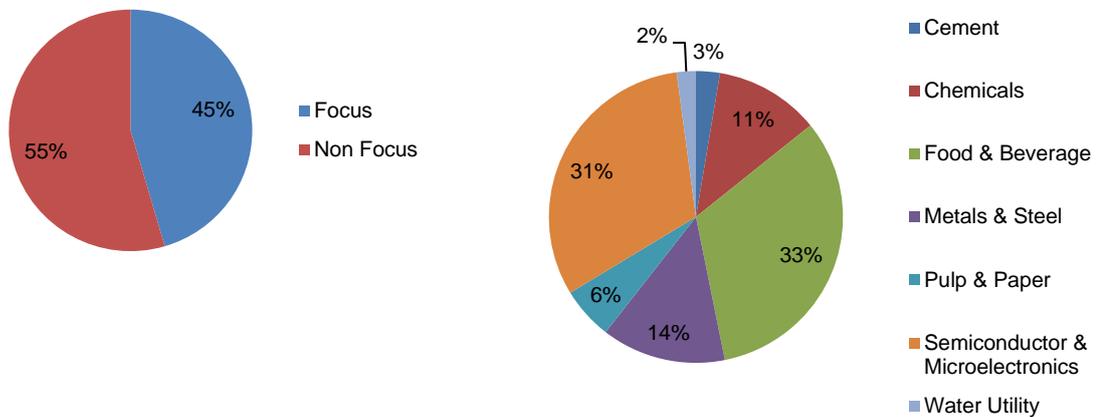
**Figure 7. Breakdown of national experts on EnMS**

As of this report, PIEEP has trained a total of 1,992 persons of which 895 attended the half-day awareness workshop while the remaining 1,097 attended the two-day user training. The project targeted at least 500 factory managers to attend the half-day workshops of which 300 are expected to commit their employees to the two-day energy management system user training. Interestingly, majority of the almost two thousand factory personnel who have attended the capacity building activities on energy management system comes from outside the target industry sectors of the project.

Aside from the expanded seven sectors that the project targeted to capacitate, factory personnel from plastics, packaging, pharmaceuticals, ceramic, fertilizer, foam, furniture, power generation, construction/real estate, disposable lighters, service providers, glass, mining, ESCOs, tobacco, and tire manufacturers have joined the training and workshops. Figures 8 and 9 shows the breakdown of participants to the half-day awareness workshops and two-day user training on energy management system, and 42% or 838 participants come from the focus industry sectors. Majority of the participants from the target sectors come from the semiconductor & microelectronics and food & beverage industries.



**Figure 8. Breakdown of participants in the EnMS Half-day awareness workshop**



**Figure 9. Breakdown of participants in the Two-day EnMS User Training**

## 2.6 ISO Compliant Energy Management Project Implementation

Forty six (46) enterprises have implemented the energy management system compliant with the ISO 50001 Standard based on an independent survey done by a third party engaged by the project. Initially, only eighteen (18) enterprises were able to

implement the system compliant with the standard at the project's beginning stage courtesy of the enterprise-based national experts.

It was a challenge for the project to increase the number of enterprises for the succeeding years as majority of the national experts are enterprise-based and cannot go out of their companies to promote and encourage other enterprises in implementing the system. Two (2) companies were added in 2015 courtesy of national experts who act as consultants to these companies and assisted them in achieving 50001 certification. Another two (2) companies were added later on through their own initiative after attending a capacity building training and sought the PMU's assistance, bringing the total to twenty two (22).

In 2017, the PMU organized another batch of training to increase the number of enterprises implementing the system compliant with the standard. Intensive two stage training was organized participated by sixty five (65) participants composed of enterprise-based and consultancy-based trainees. The enterprise-based trainees come from twenty nine (29) industrial companies, of which only twelve (12) were able to implement the energy management system compliant with the standard and bringing the total to thirty four (34). Since the target for national experts on EnMS were already met, successful trainees (12 persons) who were able to assist the enterprises in implementing the system were recognized as energy management practitioners.

In 2018, a big food and beverage company (conglomerate) approached the PMU to assist them in achieving 50001 certification for their five (5) plants located in one of their industrial complex. The PMU together with a national expert visited the office of this company and started negotiations of implementing the energy management system with a target 50001 certification by the end of 2018. As of this report, this big company was able to achieve 50001 certification of their six (6) plants.

## 2.7 Recognition Program

After the late 70s global energy crisis, the DOE started an energy recognition program called Don Emilio Abello Energy Efficiency Awards (DEAEEA) in 1982. DEAEEA has been awarding enterprises which voluntary save energy by submitting reports on company energy saving efforts annually. Since DOE is the main partner of UNIDO in implementing PIEEP, it was agreed by both parties that enterprises who have successfully implemented the energy management compliant with 50001 Standard to be recognized during annual DEAEEA event, subject to recommendation of PMU as verified by international and local EnMS experts.

To date, PIEEP has recommended to DOE the 34 enterprises recognized in the DEAEEA since 2014. In addition, the PMU also recommended to DOE to recognize the 44 national experts of EnMS, 44 national experts of SO and 12 EnMS practitioners in the DEAEEA from 2015 to 2017. **Annex D** shows the list of EnMS national experts and practitioners.

## 2.8 Outcome and Lessons Learned

Table 8 and 9 summarizes the actual achievements for this project component.

**Table 8. Number of Industrial Enterprises implementing EnMS**

Source of Information	Number of Enterprises		
	Ongoing	Completed	Total
Survey Response from Enterprises	19	5	<b>24</b>
Survey Response from NEs	9	13	<b>22</b>
<b>Total</b>	<b>28</b>	<b>18</b>	<b>46</b>

Source: IIEC Survey Assessment of Project Impact/Results (March 2019)

As can be seen in Table 8 above, the number of industries in the focus sectors implementing the system compliant with ISO 50001 exceeded the target of 40 companies. The twenty eight (28) ongoing and eighteen (18) completed implementation of EnMS based on ISO 50001 brings the total number to forty six (46). The corresponding savings and equivalent CO<sub>2</sub> emission reductions achieved by the 46 enterprises are shown in Table 9 below.

**Table 9. EnMS Results in terms of Annual Savings and CO<sub>2</sub>-Emission Reductions**

Status of Measures	From EnMS			
	Electricity Savings (MWh/y)	Fuel Savings (GJ/y)	Monetary Savings (PHP/y)	Annual Emission Reductions (tCO <sub>2</sub> e/y)
Ongoing	27,819	27,754	206,239,608	19,764
Completed	58,601	199,375	394,123,874	56,430
<b>Total</b>	<b>86,420</b>	<b>227,129</b>	<b>600,363,482</b>	<b>76,194</b>

Source: IIEC Survey Assessment of Project Impact/Results (March 2019)

The involvement of larger and better resourced industrial establishments such as conglomerates proved to be very beneficial in starting an industrial energy efficiency program since the probability is better for successfully implementing energy efficiency projects with quicker results in demonstrating benefits. The project's main objective is to introduce and encourage enterprises to implement the energy management system based on the 50001 standard but the big companies who participated in the project opted to go for certification. This action generated enough interest among target and allied industries and initiated the market transformation with respect to industrial energy efficiency adoption and implementation of an energy management system based on an international standard.

## Chapter 3. Energy Systems Optimization

This chapter presents the activities under the three systems considered under the second component of the project together with the expected outputs and outcomes. It also presents the challenges/experiences, and lessons learned in implementing energy systems optimization in steam, compressed air and pump.

### 3.1 Training Materials and Tools

Three sets of training materials were developed and used in capacity building activities for this component. One set each for steam, compressed air and pump systems were prepared and used for training. Further, there were three (3) levels of training materials developed to build the capacity of locals for each energy systems and they are described as follows:

Two-day User training is targeted at facility engineers, operators and maintenance staff of enterprises, equipment vendors and service providers and is designed to teach how to assess energy systems (steam, compress air and pump), identify potential improvement opportunities and achieve cost savings through proper operation and controls, system maintenance, and appropriate uses of each system.

The Half-day Equipment Vendors training is targeted to local energy systems equipment vendors, suppliers and manufacturers. The purpose is to introduce these key market players to energy systems optimization techniques and service offerings. The objectives of the training are:

1. to prepare manufacturers, vendors and suppliers to participate in reinforcing the system optimization message of the UNIDO project with their industrial customers; and
2. to assist manufacturers, vendors and suppliers in identifying what will be required to reshape their market offerings to reflect a system services approach.

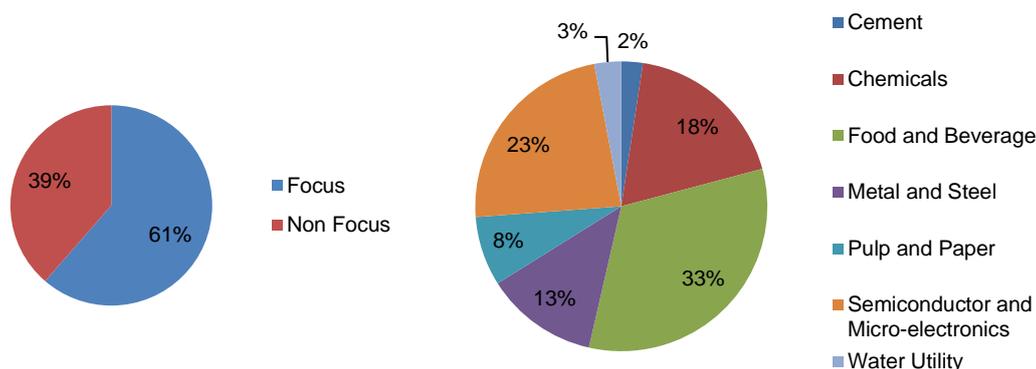
Finally, the experts' training is an intensive training delivered by leading international energy systems optimization experts to local energy efficiency experts, service providers, energy efficiency practitioners, energy equipment vendors and industry engineers. This training provides more in-depth technical information on troubleshooting and making improvements to industrial energy systems. This training also introduces basic principles for energy efficient design of energy systems, how to successfully sell energy systems improvement projects to management and how to select an energy system optimization service provider. National experts are trained through classroom, on-the-job and coaching by international systems optimization experts and equipped with the expertise, skills and the tools required for providing the following services:

1. Technical assistance to enterprises and coaching facility personnel on energy systems optimization project development and implementation; and
2. Conducting User and Vendor energy systems optimization training on systems assessment, identification of optimization measures, development and implementation of operational improvements.

### 3.2 Trained National Experts/Factory Personnel on Systems Optimization

Two batches of training for each energy system were held participated by a total of ninety (90) trainees. However, only forty four (44) candidates were able to complete with twenty two (22) local experts on steam system, fourteen (14) local experts on compressed air system and eight (8) local experts for pump system. Local experts for energy systems optimization was again dominated by enterprise-based at seventy one percent (71%) followed by consultants/freelancers at seventeen percent (17%) and those who work for the energy services at twelve percent (12%). This phenomenon presented the same problem encountered with enterprise-based EnMS local experts in increasing the number of industries implementing systems optimization projects. **Annex E** shows the list of local experts for steam, compressed air and pump systems.

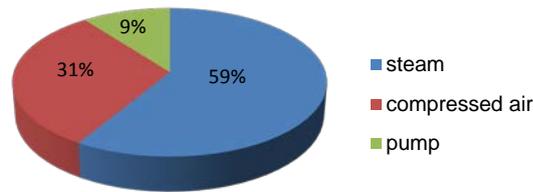
The project was able to train four hundred twenty four (424) enterprises under the three energy systems optimization two-day user training. A total of one thousand one hundred seventy two (1,172) factory personnel received the comprehensive two day user training and was dominated by participants from the focus or target sectors. Sixty one percent (61%) of the total factory personnel trained in the three systems optimization approach were from the focus sectors as shown in Figure 10 below, majority of which comes from the food & beverage sector.



**Figure 10. Breakdown of enterprises participated in energy systems optimization training**

### 3.3 Vendor Participation in the Training

Twenty nine local equipment vendors attended the half-day training designed to encourage vendors of each energy system in revising their marketing approach to promote system optimization. The training session is a mix of theory and practical considerations with emphasis on advocacy to reflect the system optimization message of UNIDO. A total of fifty eight participants joined this activity with majority coming from the steam system equipment vendor. Figure 11 shows the breakdown of vendor participation in systems optimization training.



**Figure 11. Breakdown of energy system vendor participation**

### 3.4 Documented Demonstration Projects

Thirty four (34) system assessments for steam (14), compressed air (14) and pump (6) were conducted by trained local experts. It is lower than the total of national experts trained by the project due to some candidates joining the enterprise-based candidates in assessing host plants for the three systems. This grouping system was allowed by the project since candidate experts that are not enterprise-based are having difficulty in getting permission to study and assess energy systems of industries, especially the big ones, which are very strict in terms of allowing outsiders to enter their factories albeit the non-discretion agreements signed by these candidate experts for the three energy systems.

There were only six (6) case studies prepared for systems optimization which indicated actual energy savings and GHG emission reductions verified during the survey conducted by third party evaluator.

### 3.5 Outcome and Lessons Learned

Implementing systems optimization project is a big challenge for PIEEP since projects are subjected to capital expenditure by enterprises, which mostly prioritizes production over optimization. Further, most of the projects in systems optimization are self-financed by the enterprises which implemented them due to the tedious and restrictive borrowing policies and procedures offered by local banks in financing such projects.

In addition, documenting the projects under this component of PIEEP involved a very challenging approval process on the part of the enterprises, since majority of the companies that implemented systems optimization projects does not readily provide and share information, especially on the financing aspect as well as the technical procedures and process of their operations.

A total of fifty seven (57) enterprises implemented system optimization projects, mostly on optimization measures that involved only adjustments in parameter set-up and parameter alignment as well as routine/periodic repairs & maintenance that did not require financial investments. Table 10 shows the savings and corresponding CO<sub>2</sub>

emission reductions on the three systems optimization projects implemented by the 57 enterprises

**Table 10. SO Results in terms of Annual Savings and CO<sub>2</sub>-Emission Reductions**

Status of Measures	From Systems Optimization (SO)			
	Electricity Savings (MWh/y)	Fuel Savings (GJ/y)	Monetary Savings (PHP/y)	Annual Emission Reductions (tCO <sub>2</sub> e/y)
Ongoing	1,964	378,654	115,902,600	63,969
Completed	4,505	582,766	118,089,416	74,576
<b>Total</b>	<b>6,469</b>	<b>961,420</b>	<b>233,992,016</b>	<b>138,545</b>

Source: IIEC Survey Assessment of Project Impact/Results (March 2019)

## Chapter 4. Enhancement of Financing Capacity

Chapter 4 presents the activities under the third component of PIEEP and discusses the expected results and the challenges encountered as well as the experiences of the third-party workshop and training provider contracted by the project. The outcome and lessons learned in enhancing the financing opportunities for energy efficiency projects were also presented in this chapter.

### 4.1 Harmonized Energy Efficiency Evaluation Criteria

The main objective under this activity is to develop a set of criteria/requirement that can be used by financial institutions as a guide to assess the financial viability of energy efficiency and system optimization projects. The developed criteria must be in line with Filipino banking practices and will include a scoring system that will provide guidance for bankers in determining the validity of projected energy savings resulting from proposed energy efficiency improvements.

A questionnaire was developed to facilitate the consultation meetings and the gathering of data on the current project evaluation criteria from the financial institutions including the two partner local banks mentioned in Section 1.6 of this report. **Annex F** shows a copy of the questionnaire tool developed to harmonize the evaluation criteria.

A workshop was organized by the International Institute for Energy Conservation (IIEC), the third party capacity building provider for this project component, attended by thirty (30) participants from financial institutions, industry personnel, local experts and representative of government institutions. The participants were grouped into three: (i) Financial institutions; (ii) industry; and (iii) local experts and government institution. During the workshop, an initial set of scoring scheme was proposed by IIEC to the three groups that used a point-based system adding up to a total of 100 points. The scoring scheme was based on the following criteria:

1. Suitability of the technologies
2. Qualifications of auditor/ESCO and quality of Detailed Project Report (DPR)
3. Baseline definition
4. Estimation of project costs
5. Estimation of energy and cost savings
6. Implementation team and plan
7. Risk assessment and mitigation
8. Measurement and verification

Each group reviewed the proposed scoring scheme and developed and presented their recommendations for modification to the scores assigned to the criteria. Figure 12 shows the scores assigned to the 8 criteria by each group and the average of these score for each criterion.

Criteria	IIEC	Banks/Fis	Industries	Natl. Experts/ Government	Average
Suitability of the Technologies	15	15	15	10	13.8
Auditor/ESCO Qualifications & quality of DPR	15	15	10	10	12.5
Baseline Definition	10	10	10	15	11.3
Estimation of Project Costs	15	15	15	10	13.8
Estimation of Energy and Cost Savings	15	15	20	15	16.3
Implementation Team and Plan	10	10	10	10	10.0
Risk Assessment and Mitigation	10	10	10	20	12.5
Measurement and Verification	10	10	10	10	10.0
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

**Figure 12. Recommended Scoring Scheme for the Evaluation Criteria by the Three Groups and IIEC**

Based on the results of the recommended scores by the three groups, combined with the initial proposed scheme by IIEC, a revised scoring scheme was developed and is shown in Figure 13.

Criteria	No. of Points
Suitability of the Technologies	14
Auditor/ESCO Qualifications & quality of DPR	13
Baseline Definition	11
Estimation of Project Costs	14
Estimation of Energy and Cost Savings	16
Implementation Team and Plan	10
Risk Assessment and Mitigation	12
Measurement and Verification	10
<b>Total</b>	<b>100</b>

**Figure 13. Revised Maximum Point Scores of the Evaluation Criteria**

Participants to the workshop agree to the modified weights assigned to each criterion as shown above. The modifications are in line with Filipino banking practices and include a scoring system that provides guidance for bankers in determining the validity of projected energy savings resulting from proposed energy efficiency improvements. **Annex G** shows the Guidelines on the Harmonized Project Evaluation Criteria for EE Projects.

## 4.2 Training Material for Managers Developed

Training materials were developed for financial managers, factory managers as well as national experts. The materials for factory managers and national experts were the same but the set of training materials is a little bit different for the financial institution managers. For the latter, the aim is to improve the access to financing assistance by

easing the barrier of restrictive borrowing policies by local banks at the same time encourage industries to access the loans being offered. As the current practice of financial institutions in the Philippines is to hire an external technical expert in evaluating loans for EE projects and pass to their customers the cost incurred in getting this assistance through their payments, IIEC developed a simple financial modelling tool to help bank managers/staff as well as industry managers/staff in evaluating and developing viable EE project proposal respectively. Together with the guideline developed in the harmonization workshop, guidelines in using the automated worksheet for financial modelling of EE projects and development of financial proposals for EE projects are shown in **Annexes H** and **I** respectively.

### 4.3 Managers Trained on Financial Aspects of Energy Efficiency Projects

Table 11 shows the number of bank managers and factory managers/local experts trained by IIEC in evaluating and preparing bankable EE projects respectively. Two one-day trainings were organized, one in Manila and the other one in Cebu in 2016. Feedback from the training in Manila from financial institutions emphasized the need for more time allotted to do the exercise in financial modelling using the spreadsheet provided to them. They also suggested more time for Q & A, thus one day is not enough for the training. However, all the participants agreed that the topics presented were relevant, applicable and very important on their current function specifically on the topic on financial evaluation of EE projects. In addition, the guidelines in using the automated worksheet for the financial modelling of investment projects was found to be very useful tool for in analysing and approving new projects.

**Table 11. Managers trained in the financial aspects of energy efficiency projects**

Personnel	Target	Actual	Remarks
National Experts	40	38	
Factory managers and staff	100	74	from 43 factories
Financial institution managers	50	52	from 22 financial institutions

Feedback from the training in Cebu is very positive as all participants actively participated in the exercises, which helped them further in understanding the topics on energy efficiency financing.

#### **4.4 Support for Loan Packaging (risk assessment, technical, financial and legal concerns)**

Support for packaging of loans for EE projects were included in the two one-day training conducted by IIEC. The training covered the topics on project development cycle, market analysis, technical aspects, financial analysis, economic cost-benefit analysis, and project implementation. As a bonus, IIEC offered free support to industry participants who will apply for loan on EE projects to evaluate their proposal before submission to banks to ensure approval. **Annex J** shows the training program for financial institution and industry.

#### **4.5 Outcome and lessons learned**

To date, none of the industry participants have approached IIEC or the project for assistance in accessing financial assistance with their planned EE projects even though the IIEC have offered assistance in reviewing the project proposals of industry prior to submission to financial institutions for free. This phenomenon reflects the overall view of the restrictive borrowing procedures of financial institutions in the country with respect to EE projects. In addition, most industries self-financed their EE projects to avoid the tedious loan process offered by local banks.

## Chapter 5. Project Monitoring

This Chapter presents a summary of the findings during the mid-term and terminal evaluation of the project together with the conclusion and recommendations of the independent evaluators at the time of both evaluation.

### 5.1 Mid-Term Project Evaluation

In 2015, a mid-term evaluation of the project was conducted to assess project performance and progress against the following evaluation criteria: relevance, effectiveness, efficiency, sustainability and impact. It was carried out as an independent in-depth evaluation using a participatory approach whereby all key parties associated with the project were interviewed and consulted throughout the evaluation conducted on March 16-20, 2015. The independent evaluation is guided by UNIDO Evaluation Policy and Guidelines for the Technical Cooperation Programmes and Projects, and the GEF's Guidelines for Implementing and Executing Agencies to Conduct Evaluations, Monitoring and Evaluation Policy and Recommended Minimum Fiduciary Standards for GEF Implementing and Executing Agencies.

Table 12 shows the summary of findings during the mid-term project evaluation.

**Table 12. Summary of findings during the project's Mid-Term Evaluation**

Criteria	Rating
Relevance	Highly relevant
Effectiveness	Satisfactory
Efficiency	Satisfactory
Sustainability and impact	Likely

At the time of the mid-term evaluation of the project, a new National Project Coordinator (NPC) has just been hired, after almost a year and a half of operating without an NPC (October 2013-February 2015). Nevertheless, the PMU were able to continue some of the planned activities with the Industry Liaison Officer (ILO) acting as Officer in Charge (OIC) of the project. Despite this setback, the project was satisfactorily guided and managed by the UNIDO Project Manager. The overall findings at the time of the mid-term project evaluation was that the project has been quite effective to date, despite encountering some delays in project implementation, with most planned outputs being achieved by the time of the mid-term review and are expected to be on track by the end of 2015, since the absence of an NPC was already addressed.

The problems encountered during project implementation, from establishing a working PMU up to the absence of an NPC for one and half years, cause some delays in implementing activities, specifically in Component 3 of the project. Nevertheless, Components 1 and 2 of the project were satisfactorily implemented and some of the targeted outputs were already achieved e.g. training of local experts, organizing awareness workshops. However, it was also during the time of mid-term review that the

proposed end date of the project, originally scheduled in November 30, 2016 was revised to be extended until May 31, 2017, to recover the time lost due to the problems encountered mentioned above. The following recommendations are listed as a result of the mid-term project evaluation for the consideration of the project team and partner national government institutions by the independent evaluators:

- a. Establishment of an energy efficiency experts association
- b. Institutionalization of training
- c. Post-project action plan
- d. Future financing of EE projects
- e. Gender disaggregation index
- f. Website of EnMS and SO project results to be hosted by UNIDO
- g. Flexibility in co-financing should be considered at the project design stage

**Annex K** shows the full mid-term evaluation report of the project.

## 5.2 Terminal Evaluation

The terminal evaluation of the project was conducted on January 14-23, 2019. By this time, the revised project end date of May 31, 2017 was changed to December 31, 2018, which was further extended until March 31, 2019 to allow proper project closure. The revised project end date was mainly due to the following development: i) request of the main government counterpart, the DOE, to further assist them in promoting and gather more support with the proposed energy efficiency and conservation bill; ii) ongoing assistance by the PMU with the country's conglomerates in implementing EnMS and SO; and iii) finalized the Memorandum of Understanding (MoU) facilitated by the project with institutional partners that wanted to adopt and implement the energy management system.

The partnership with institutional organizations started as early as 2015 in the case of the Philippine Economic Zone Authority (PEZA) but were finalized only in 2016 and as recent as 2018 with the Quezon City local government as well as the Philippine Association of Water Districts (PAWD). Likewise, the project's engagement with the conglomerates started in 2016, but was completed in 2017, while the others were finalized at the end of 2018. These opportunities brought positive impacts to the project as it provided more time to deliver the expected target and outcome.

Table 13 presents the summary of the findings during the terminal evaluation of the project.

**Table 13. Summary of findings during Terminal evaluation**

Criteria	Rating
Project Design	Moderately satisfactory
Relevance	Highly satisfactory
Effectiveness	Satisfactory
Efficiency	Satisfactory
Sustainability of benefits	Moderately likely

Monitoring and Evaluation	Satisfactory
Quality at Entry/Preparation and Readiness	Satisfactory
Implementation approach	Satisfactory

Overall, the evaluators rated the project as satisfactory, since it was able to spur and encourage industries in the Philippines to implement energy management system based on ISO 50001 combined with systems optimization initiatives.

The evaluators listed the following recommendations for UNIDO and partner government agencies in the Philippines as well as for relevant stakeholders.

1. Prepare a detailed profile of the Philippines industrial sector that will provide DOE a basis for identifying future industrial energy efficiency (IEE) programmes
2. Identify strategic needs for facilitating “industrial sectoral” implementation of the Energy Efficiency and Conservation Act (EECA)
3. During initial phase of industrial sectoral implementation of EECA, focus on developing “process minimum energy performance standard (MEPS)” to facilitate use of best energy efficiency (EE) technologies and equipment
4. Sustain strengthened linkages with institutional partners built under PIEEP including local government units (LGUs), water districts, electric cooperatives, hospital associations, and Philippine Economic Zone Authority (PEZA) under a green city initiative
5. Immediately undertake actions to form an EnMS experts association
6. Strengthen linkages with universities and technical colleges to include EnMS and systems optimization in their curriculum
7. Seek donor funding from bilateral sources to bridge the period between the end of PIEEP (31 March 2019) and the commencement of the subsequent project in energy efficiency
8. If possible and with Department of Energy (DOE) consent, expand scope of IEE to include renewable energy (RE) solutions in subsequent programming with the Philippines to reduce operational costs and improve competitiveness of industrial sector
9. Assist DOE to strengthen linkage with Philippines Banks focusing on energy efficiency lending window
10. Assist DOE to intensify PEZA involvement in developing and mainstreaming industrial parks in the Philippines to Eco-Industrial Zones or Parks (EIPs)

**Annex L** shows the full terminal evaluation report of the project.

### 5.3 Conclusion and Recommendations

Prior to PIEEP, energy efficiency in Philippine industries is done in an ad hoc manner. The country’s industrial sector usually implement energy saving measures only during periods of high energy prices and mostly rely on internal capability and technical efforts. Moreover, Philippine industries are faced by the following barriers that further prevent them from adopting energy efficiency practices: (1) Lack of information on

energy management services market; (2) Lack of market interest in energy efficiency; (3) Slow penetration of energy efficiency know-how and technologies; (4) Unsustainable culture of efficiency in energy utilization; and (5) Opportunities and challenges of a restructured electric industry. Given these barriers, efforts to improve energy efficiency have not been consistent and do not enjoy continuous attention from senior industry managers and most importantly, the top management.

With PIEEP, the abovementioned barriers were removed and a structured and programmatic approach in energy efficiency started to gain attention that led to gradual adoption of cost effective energy efficiency as a matter of standard practice. PIEEP served as a catalyst in transforming the energy efficiency landscape of Philippine industries towards a wider audience. The project gained attention outside its target industries and was even able to attract other sectors, especially in the building and commercial, the importance of energy efficiency as a strategic tool in managing energy.

## Chapter 6. Project Sustainability

The Philippine Industrial Energy Efficiency Project (PIEEP) was able to transform the energy efficiency landscape of the country and contribute to the promotion and awareness building on the importance of energy efficiency as a strategic tool in managing energy.

Taking into consideration the results of both the mid-term and terminal evaluations conducted on the project, the following recommendations must be done to ensure the sustainability of benefits gained by the project.

**1. Strengthening the linkage with conglomerates** – partnerships with big and better resourced companies proved to be very beneficial in transforming the energy efficiency perception of the industries in the Philippines. Conglomerates, aside from having ample resources, have shown the ease with which they can adopt and/or integrate energy management system within their organization. Big companies have also the added benefit of influencing their respective production chain, whether it is raw material suppliers or third party service providers. Big companies can require their suppliers and/or service providers to adopt the energy management system or systems optimization approach in their own operations so that they can continue their business relations.

**2. Strengthen partnerships with institutional organizations** – Philippine Economic Zone (PEZA) and the Quezon City local government has the organizational capability to mandate the adoption of energy management system and systems optimization within their jurisdiction. Both of these organizations have institutional policies that can be used in requiring business locators in their administered areas to be compliant with energy management system based on ISO 50001. Special interest industry association like the Philippine Association of Water Districts (PAWD), on the other hand, can mandate member water districts to implement the energy management system on a continuous basis to ensure profitability and at the same time conserve not only energy but also water resources. With the signed Memorandum of Understanding (MoUs) facilitated by the project between these entities and the Department of Energy (DOE), the lasting change is ensured of being able to continue over a long period of time. **Annex M** shows the copies of the signed MOUs between DOE and these three institutional organizations.

**3. Strengthening the linkage with financial institutions** – as mentioned under Chapter 4 of this report, no industry seek the assistance of IIEC in getting financial assistance to fund their energy efficiency initiative/s. Instead, most companies self-financed their energy efficiency projects to avoid the tedious process of applying for a bank loan. This barrier must be removed and the DOE must act as a facilitator in linking financial institutions and industry to fund the energy efficiency efforts of the latter and develop partnerships.

**4. Formation of an energy efficiency experts' association** – both the mid-term and terminal evaluation monitoring of the project recommended this action. The formation of an association will play a crucial role once the energy efficiency and conservation law

takes effect as it will serve as DOE's partner in assisting companies to comply with the law. In addition, the association will also serve as a training institution that will capacitate energy managers and practitioners in setting up the energy management system and conduct of site assessment.

**5. Forge partnership with academia to include energy management system and systems optimization approach in their curriculum** – this recommendation will ensure that the needs of the industry will be supplied by better informed and well equipped human resource on the concepts and procedures of ISO-based energy management system once the students graduate and enter the work environment.