

Independent Terminal Evaluation

Industrial Energy Efficiency in Thailand

UNIDO Project No.: 103071

GEF ID: 3786



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Independent Evaluation Division
Office of Evaluation and Internal Oversight

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We hope that some of the proposed recommendations will contribute to the continuous improvement of future projects and to the achievement of the expected results in the next project "Greening Industry through Low Carbon Technology Applications for SMEs".

List of acronyms and abbreviations

Abbreviation	Meaning
AB	Accreditation body
ASEAN	Association of Southeast Asian Nations
BEHRD	Bureau of Energy Human Resource Development
CB	Certification body
CIMB	Commerce International Merchant Bankers
CO ₂	Carbon dioxide
DEDE	Department of Alternative Energy Development and Efficiency
DIP	Department of Industrial Promotion
DIW	Department of Industrial Works
ECP	Energy Conservation and Promotion
EE	Energy efficiency
EMS	Environment Management Standard
EEP	Energy Efficiency Plan
EERF	Energy Efficiency Revolving Fund
ENCON	Energy Conservation Promotion
EnMS	Energy Management Standard
ESCO	Energy service company
FTI	Federation of Thai Industries
GEF	Global Environment Facility
GHG	Greenhouse gas
GJ	Giga Joule
HQ	Headquarters
IEE	Industrial Energy Efficiency
ISO	International Organization for Standardization
ktoe	Kiloton of oil equivalent
kVA	Kilovolt-Ampere
kW	Kilowatt
kWh	Kilowatt-hour
M&E	Monitoring and evaluation
MJ	Mega Joule

Abbreviation	Meaning
mtoe	Million tons of oil equivalent
MTR	Mid-Term Review
MW	Megawatt
MWh	Megawatt hours
NGO	Non-governmental organization
NPC	National Project Coordinator
PMU	Project Management Unit
PRE	Person Responsible for Energy
PSC	Project Steering Committee
RE	Renewable energy
SAP	Systems Applications Product
SC	Steering Committee
SMART	Specific, Measurable, Achievable, Relevant and Time-bound
SME Bank	Small and Medium Enterprise Development Bank of Thailand
SO	System optimization
t CO ₂	Tons of carbon dioxide (equivalent)
TEM	Total Energy Management program (of DIP)
THB	Thai Baht
TIEB	Thailand Integrated Energy Blueprint
TISI	Thai Industrial Standards Institute
TLC	Training of Lead Consultancy project (of TISI)
TWh	Terawatt hours
UNIDO	United Nations Industrial Development Organization
USD	United States dollar

Glossary of evaluation-related terms

Term ¹	Definition
Activity	Actions taken, or work performed through which inputs, such as funds, technical assistance and other types of resources are mobilized to produce specific outputs.
Assumptions	Hypotheses about factor or risks which could affect the progress or success of a development intervention.
Beneficiaries	The individuals, groups, or organizations, whether targeted or not, that benefit, directly or indirectly, from the development intervention.
Conclusions	Conclusions point out the factor of success and failure of the evaluated intervention, with special attention paid to the intended and unintended results and impacts, and more generally to any other strength or weakness. A conclusion draws on data collection and analyses undertaken, through a transparent chain of arguments.
Data collection tools	Methodologies used to identify information sources and collect information during an evaluation.
Effect	Intended or unintended change due directly or indirectly to an intervention.
Effectiveness	The extent to which the development intervention's objectives were achieved, or are expected to be achieved, taking into account their relative importance.
Efficiency	A measure of how economically resources/inputs (funds, expertise, time, etc.) are converted to results.
Evaluation	The systematic and objective assessment of an ongoing or completed project, programme or policy, its design, implementation and results. The aim is to determine the relevance and fulfilment of objectives, development efficiency, effectiveness, impact and sustainability.
External evaluation	The evaluation of a development intervention conducted by entities and/or individuals outside the donor and implementing organizations.
Finding	A finding uses evidence from one or more evaluations to allow for a factual statement.
Goal	The higher-order objective to which a development intervention is intended to contribute.
Impacts	Positive and negative, primary and secondary long-term effects produced by a development intervention, directly or indirectly, intended or unintended.
Independent evaluation	An evaluation carried out by entities and persons free of the control of those responsible for the design and implementation of the development intervention.
Indicator	Quantitative or qualitative factor or variable that provides a simple and reliable means to measure achievement, to reflect the changes connected to an intervention, or to help assess the performance of a development actor.
Inputs	The financial, human, and material resources used for the development intervention.

¹ For more related terms and definitions see also: OECD (2010), UNDG (2011), UNIDO (n.d.)

Term ¹	Definition
Lessons learned	Generalizations based on evaluation experiences with projects, programs, or policies that abstract from the specific circumstances to broader situations. Frequently, lessons highlight strengths or weaknesses in preparation, design, and implementation that affect performance, outcome, and impact
Logical framework (Log frame)	Management tool used to improve the design of interventions, most often at the project level.
Mid-Term Review	Evaluation performed towards the middle of the period of implementation of the intervention.
Monitoring	A continuing function that uses systematic collection of data on specified indicators to provide management and the main stakeholders of an ongoing development intervention with indications of the extent of progress and achievement of objectives and progress in the use of allocated funds.
Outcome	The likely or achieved short-term and medium-term effects of an intervention's outputs.
Outputs	The products, capital goods and services which result from a development intervention; may also include changes resulting from the intervention which are relevant to the achievement of outcomes.
Project or program objective	The intended physical, financial, institutional, social, environmental, or other development results to which a project or program is expected to contribute.
Quality assurance	Quality assurance encompasses any activity that is concerned with assessing and improving the merit or the worth of a development intervention or its compliance with given standards.
Recommendations	Proposals aimed at enhancing the effectiveness, quality, or efficiency of a development intervention; at redesigning the objectives; and/or at their allocation of resources. Recommendations should be linked to conclusions.
Relevance	The extent to which the objectives of a development intervention are consistent with beneficiaries' requirements, country needs global priorities and partners' and donors' policies.
Reliability	Consistency or dependability of data and evaluation judgments, with reference to the quality of the instruments, procedures and analyses used to collect and interpret evaluation data.
Results	The output, outcome or impact (intended or unintended, positive and/or negative) of a development intervention.
Results chain	The causal sequence for a development intervention that stipulates the necessary sequence to achieve desired objectives-beginning with inputs, moving through activities and outputs, and culminating in outcomes, impacts, and feedback.
Results framework	The program logic that explains how the development objective is to be achieved, including causal relationships and underlying assumptions.
Review	An assessment of the performance of an intervention, periodically or on an ad hoc basis.

Project factsheet

Table 1 Project factsheet for Industrial Energy Efficiency in Thailand

Project title	Industrial Energy Efficiency in Thailand
PROJECT ID	103071
GEF ID	3786
Region	EAP
Country	Thailand
Project donor	GEF
Project CEO Endorsement / project approval date	February 4 th , 2011
Project implementation start	<i>Expected: January 1st, 2011, Actual: March 6th, 2012</i>
Implementation end	<i>Expected: August 31st, 2016, Actual: September 30^s, 2018</i>
Duration of the project	<i>Expected: 66, Actual: 78 months</i>
Executing partners	Department of Industrial Promotion (DIP); Department of Industrial Works (DIW); Thai Industrial Standards Institute (TISI); Department of Alternative Energy Development and Efficiency (DEDE)
Donor funding	USD 3,620,000
Co-financing	USD 15,645,000
Total project cost	USD 19,265,000
GEF project preparation grant	USD 100,000
Mid-term review date	April 2016

Source: own table.

Executive Summary

Introduction

This report presents the findings of the Independent Terminal Evaluation of the project “Industrial Energy Efficiency in Thailand” (herein referred to as “the project” or “**IEE project Thailand**”), implemented by the United Nations Industrial Development Organization (UNIDO) with a financing grant provided by the Global Environment Facility (GEF).

The objective of the IEE project was to increase the energy efficiency of industrial operations as well as to make them more reliable and competitive. The approach of the project was to promote ISO-based energy management standards and systems optimization methods for improvement of energy performance of industries. To achieve the project’s objective, four components were carried out: component 1. ISO compliant energy management systems, component 2. Industrial energy systems optimization, component 3. Enhancement of industrial EE financing capacity, and component 4. Implementation of energy management and systems optimization projects.

The IEE project Thailand was a full-sized project executed under GEF IV replenishment having UNIDO as the implementation agency and the Department of Industrial Promotion (DIP), the Department of Industrial Works (DIW), the Thai Industrial Standards Institute (TISI), and the Department of Alternative Energy Development and Efficiency (DEDE) acting as the local counterparts.

The original project budget consisted of USD 3,620,000 from GEF and USD 15,645,000 as national co-financing. The project started implementation on March 6th, 2012 and ended in September 2018.

Evaluation purpose and methodology

This Terminal Evaluation was conducted in compliance with GEF requirements. An evaluation team of two experts, national evaluation consultant Ms. Tharee Kamuang and international evaluation consultant Ms. Sarah Rieseberg conducted the Terminal Evaluation. Ms. U. Müge Dolun from UNIDO’s Independent Evaluation Division accompanied the team on the field mission.

The objectives of the project evaluation are to:

- i. Assess the project performance in terms of relevance, effectiveness, efficiency, sustainability and progress to impact;
- ii. Develop a series of findings, lessons and recommendations for enhancing the design of new and implementation of ongoing projects by UNIDO.

The evidence for the evaluation process was systematically collected through document reviews, interviews and surveys. The evaluation process started with a review of project documents which provided the general context of the project activities to be evaluated as well as their expected results. The field mission took place in the period of May 30th, 2018 to June 8th, 2018. The evaluation field mission included face-to-face interviews with the national counterparts, the project’s stakeholders and with participating experts and companies. Preliminary findings were discussed with staff at UNIDO HQ in Vienna in December 2018, leading to a final report in January 2019.

Key Findings

A) **Impact (or progress toward impact):** The project has successfully promoted industrial energy efficiency and industrial productivity in Thailand and created a solid foundation for long term impacts. The IEE project Thailand has been an effective enabler of energy efficiency implementation and has directly and indirectly contributed to energy, financial and greenhouse gas savings. The project introduced several methodological approaches on how to manage energy in Thailand. The project has focused on capacity building for the implementation of EnMS and systems optimization. The project played a significant role in mainstreaming ISO 50001 among industry in Thailand: 25 IEE-intervention companies concluded a certification, amounting to 10 % of all ISO 50001 certification in Thailand in 2016. The project has provided opportunities for hands-on practical experience of the trainees and the implementation of projects in participating pilot factories. The achievements in the financial component were slightly weaker than the outstanding achievements in the capacity building and implementation components. On impact level the project overachieved on its electricity-saving target by 133 %, its fuel-saving target by 142 % and its GHG emission reduction target by 126 %. Achieving a gross emission reduction of 197 Kt CO₂.

B) **Project design:** The project design is rated with respect to the overall design and the logframe.

1. **Overall design.** The overall design was satisfactory and was followed throughout the project implementation. The design was still valid by the end of the project. The project might have benefited from a policy and enabling environment component to engage in strategy discussions for the further advancement of the already robust energy efficiency policies in Thailand. The loan schemes included in the budget were not necessary as the project targeted at this stage low-cost energy efficiency investments.
2. **Logframe.** The logframe design is moderately satisfactory. Most, though not all, output level indicators were SMART and meaningful, but no outcome indicators were determined making it difficult to track the long-term effect the project might have had. Almost all data sources chosen at project design stages were suitable for monitoring. Though assumptions were discussed in the project document, since outcomes were lacking from the logframe, the most relevant assumptions were missing.

C) Project performance

1. **Relevance.** The assessment of national policies and strategies of the Government of Thailand, GEF's strategic priorities and objectives as formulated in the Strategic Program IV.2. Promoting Energy Efficiency in the Industrial Sector, and UNIDO's mandate concluded that the project was relevant to the stakeholders. The overall project design was relevant to the national energy priorities and has enjoyed the strong participation of local stakeholders in project identification and implementation. The project is fully relevant to UNIDO and relevant to the GEF focal area of climate change.
2. **Effectiveness.** The project has been under implementation for almost seven years and its achievements compared to the targets show highly satisfactory results. In many cases, the project exceeded its end-of-project targets and reacted to the high demand by adding capacity building related activities in addition to the project design. The review has concluded that all efforts were undertaken to ensure cost-effectiveness of the project results both by UNIDO as IA, PMU, and the national project counterparts. In terms of the effectiveness of the project approach, it should be noted that the institutional design did

not lend itself to fully leverage the cooperation potential with similar training efforts carried out by DEDE's Bureau of Energy Human Resource Development. In terms of impact achievement, it should be noted that many of the participating energy-using enterprises are companies that already have to adhere to energy management obligations set out in the Energy Conservation Promotion Act for designated companies. The mature policy context served as a fertile ground for further energy efficiency improvements induced by the project.

- 3. Efficiency.** Efficiency is rated with respect to the extent to which the project has produced results within the expected budget and time frame. The project was an efficient use of resources and produced far more outputs in terms of training courses offered than set out in the project design. Although counterpart resources and adequate project management arrangements were in place at project entry, the project has experienced some delays, particularly to finalize its impact monitoring activities. The project was extended by 13 months until September 2018.
- 4. Sustainability.** The overall sustainability rating for this project is likely. There were no direct risks identified that affect the dimension of project sustainability, particularly not with respect to financial, socio-political, institutional framework and governance risks. In the field of environmental (ecological) risks, the nature of the project type demands a more analytical approach to indirect and direct rebound effects which can lead to a significant difference between gross and net effects or even leading to an overshoot situation.

In terms of longevity of results, there is no risk that energy management systems and system optimization will become redundant because Thailand has established a robust policy framework obliging the industry to pay considerable attention to energy efficiency. Nevertheless, the project did not achieve a full-scale institutionalization and take-up of its approaches and materials by the counterpart institutions. The project did make an effort to start closer cooperation with university institutions which can be considered as an innovative and pro-active approach to increasing the long-term sustainability of the project's effects.

D) Cross-cutting performance criteria

- 1. Gender mainstreaming.** Gender was not considered during project design or included after UNIDO passed its gender policy in 2015. The MTR encouraged the collection of sex-disaggregated indicators, which showed that 17 % of beneficiaries were females. No negative gender impacts were identified. Since no female international experts could be recruited by the project, an opportunity to present female role models in the sector could not be taken advantage of.
- 2. M&E.** The M&E process and specific reporting requirements were sufficient to track the output targets and collect information about gross impacts (fuel savings, energy savings, GHG emission reductions) realized. The budget provided for M&E at the planning stage was sufficient. The project collected an impressive set of additional data, e.g. course feedbacks, but since the monitoring of such activities had not been listed in the reporting obligations, the data was not available in a concise form.

E) Performance of partners

- 1. UNIDO.** Project management has been highly successfully carried out by the UNIDO Project Manager and Project Management Team (PMT) led by the National Project

Coordinator (NPC). PMU drafted the progress reports that provide the necessary aspects of the periodical achievements of the project, clearly linked the achievements with the output indicators of the logical framework. The reports are well laid out and highlight key achievements with icons. The report layout can serve as a model for other IEE projects. The Project Manager organized meetings of different National Coordinators in the region to learn and leverage experience outside of the country.

2. **National counterparts.** There has been good cooperation between the various project partners (DIP, TISI, DEDE, and DIW) that closely work together with the PMU, met almost annually in the Project Steering Committee (PSC) and have set up a Working Group. A closer cooperation with the remaining training activities provided by the Thai government would have been beneficial to the institutionalization of project results.
 3. **Donor.** GEF disbursed funds in time and participated actively in project activities.
- F) **Overall assessment:** The IEE project was a successful and well-designed project complementing the existing impressive efforts by the Kingdom of Thailand in the field of energy efficiency. The project demonstrated a strong ability to learn and adapt its training offers according to local needs. The sustainability of the projects' results was negatively affected by the discontinuity of training activities by key counterparts which resulted in a lower institutionalization of training efforts than might have been hoped for. Nevertheless, the project leaves a strong legacy and played a lead role in driving ISO 50001 in Thailand. It contributed to an environment, particularly through capacity development, that enabled the consolidation of an energy efficiency market in Thailand.

Recommendations

The following lessons learned derived from this Terminal Evaluation:

- **To UNIDO:** Monitoring of project impacts could be improved with respect to the following aspects:
 - **Improve the assessment of attribution**, e.g. by better tracking free-rider effects to strengthen the meaningfulness and reliability of the data collected.
 - **Introduce a standard approach for consideration of rebound effects or standardized tools to assess rebound effects.**
 - **Pay more attention to SMART outcome indicators.**
 - **Use coherent survey tools** to monitor training participants' feedback.
 - **Measure the outreach of awareness components**, there is a lack of verification how far case studies and other materials are spread among the target group.
- **To UNIDO: Gender mainstreaming.** UNIDO should increase its efforts to deploy female international experts into partner countries.
- **To UNIDO: Secure parts of the awareness budget for the finalized project website.** In a comparatively mature market for energy efficiency, it might be useful to move some of the national awareness campaign budget to the end of a project to draw attention to a central media outlet such as the IEE website which is filled with local IEE content and particularly with case studies only late in the project lifetime.

- **To UNIDO: *Future projects might want to pay more careful attention to the needs of the independent national experts to work as energy advisers***, e.g. by equipping them if needed with necessary business skills.
- **To UNIDO: *Projects should be embedded in a broader vision of resource efficiency and decarbonisation***. Considerations of embedded energy, resource consumption and decarbonisation (e.g. by including renewable energy) should find their way into designing IEE projects.
- **To GEF and UNIDO: *GEF should clarify concerns with specific sectors***. Several of the sectors targeted by the IEE portfolio are high-environmental impact sectors contributing to significant amounts of pollution and natural habitat destruction, among them petrochemical industries including single-use plastics-producers, mining, palm oil plantations, and petroleum refineries. Some of such high-impact sectors were also targeted in the case of the project at hand. While damages are not caused by the project itself, the efficiency gains promoted by the project can potentially improve the profitability of these activities hence resulting in environmental risks unless specific measures are undertaken to mitigate them. GEF and UNIDO should define more clearly the due diligence processes under which work with certain types of industries are allowed, e.g. obliging partner companies to adhere to sectoral sustainability certifications.
- **To GoT and UNIDO: *More careful attention should be paid to the institutionalization of project results and coordination with existing national initiatives***, in the case of the project at hand a policy component might have served to serve this purpose.
- **To GoT: *Closer cooperation of government stakeholders***, in the case at hand after other stakeholders discontinued their training activities a stronger involvement of DEDE might have benefited the coordination and institutionalization of project results.

Lessons

- The pilot companies do not only have to fulfil formal requirements such as technologies in use but are more effective if they are also willing to engage with other companies and share their experiences publicly and among company networks.

Good practices

- The project prepared excellent reports which presented the findings in a well-laid out fashion. Such a format could serve as an example for other projects.
- The team carried out an online course to maximize knowledge sharing in remote destinations.
- PMU addressed the academic community as an additional element for setting framework conditions. Closer cooperation with educational institutions might be a useful addition to similar projects.

Project ratings

#	Evaluation criteria	Rating in the Terminal Evaluation	Rating in the Midterm Review
A	Impact (or progress toward impact)	Satisfactory	
B	Project design	Moderately satisfactory	HS (Highly satisfactory)
1	Overall design	Satisfactory	/
2	Logframe	Moderately satisfactory	/
C	Project performance	Satisfactory	
1	Relevance	Satisfactory	HR (highly relevant)
2	Effectiveness	Satisfactory	S (Satisfactory)
3	Efficiency	Satisfactory	S (Satisfactory)
4	Sustainability	Likely	L (Likely)
D	Cross-cutting performance criteria	Satisfactory	
1	Gender mainstreaming	Moderately satisfactory	
2	M&E: - M&E design - M&E implementation	Satisfactory	HS (Highly satisfactory)
3	Results-based Management (RBM)	Satisfactory	
E	Performance of partners	Satisfactory	
1	UNIDO	Highly satisfactory	
2	National counterparts	Satisfactory	
3	Donor	Highly satisfactory	
F	Overall assessment	Satisfactory	

1. Introduction

1.1. Evaluation objectives and scope

The objective of this independent Terminal Evaluation is to assess the relevance, effectiveness, efficiency, sustainability and progress to impact of UNIDO's IEE Thailand project (PROJECT ID 103071 / GEF ID 3786), referred to from here onwards as 'the project'. The evaluation assesses the project based on the following criteria:

- A) Impact / progress toward impact,
- B) Project design,
- C) Project performance with the sub-criteria relevance, effectiveness, efficiency, and sustainability of benefits,
- D) Cross-cutting performance criteria, and
- E) Performance of partners.

The second purpose of the evaluation is to draw on findings and lessons learned, provide recommendations for future projects, and to help UNIDO improve upon the identification, preparation, and implementation of the Industrial Energy Efficiency related programmes.

The key evaluation questions are the following:

- a) What are the key drivers and barriers to achieve the long-term objectives? To what extent has the project helped put in place the conditions likely to address the drivers, overcome barriers and contribute to the long-term objectives?
- b) How well has the project performed? Has the project done the right things? Has the project done things right, with good value for money?
- c) What have been the project's key results (outputs, outcome, and impact, if possible)? To what extent have the expected results been achieved or are likely to be achieved against the project design? To what extent the achieved results will sustain after the completion of the project?
- d) What lessons can be drawn from the successful and unsuccessful practices in designing, implementing and managing the project?

The terms of reference of the Terminal Evaluation are detailed in Annex I.

1.2. Overview of project context

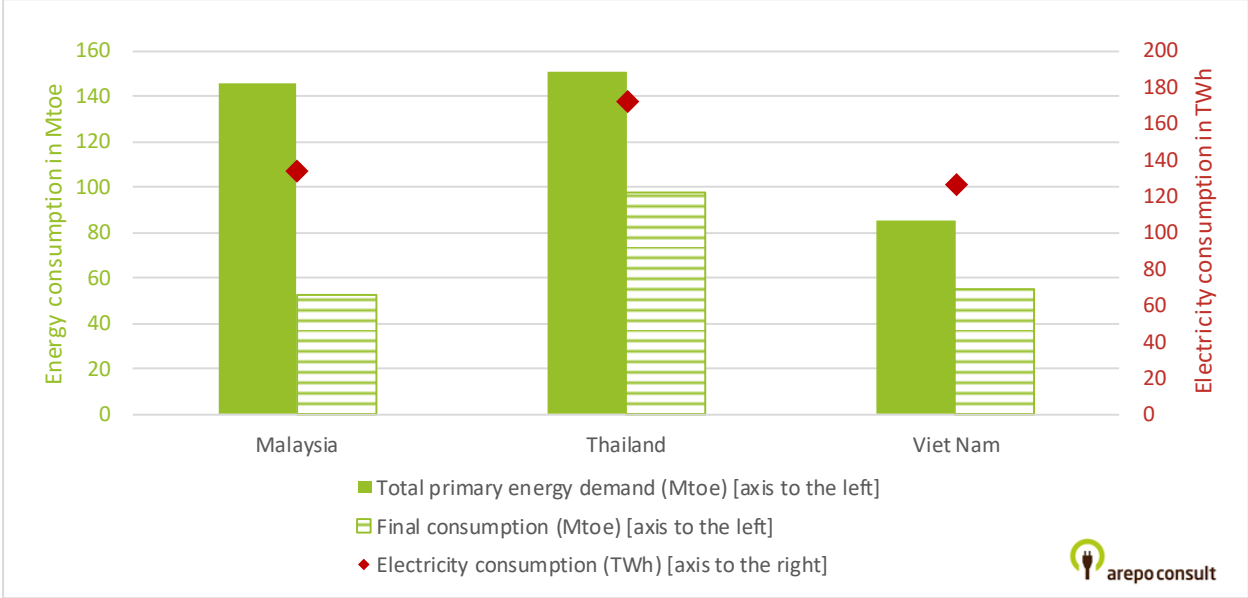
Thailand has a population of 68.1 million (2016) with a total primary energy demand of 154 Mtoe and a final consumption of 98,04 Mtoe.² Electricity consumption is close to 180 TWh.³ Figure 1

² IEA (n.d.).

³ IEA (2018).

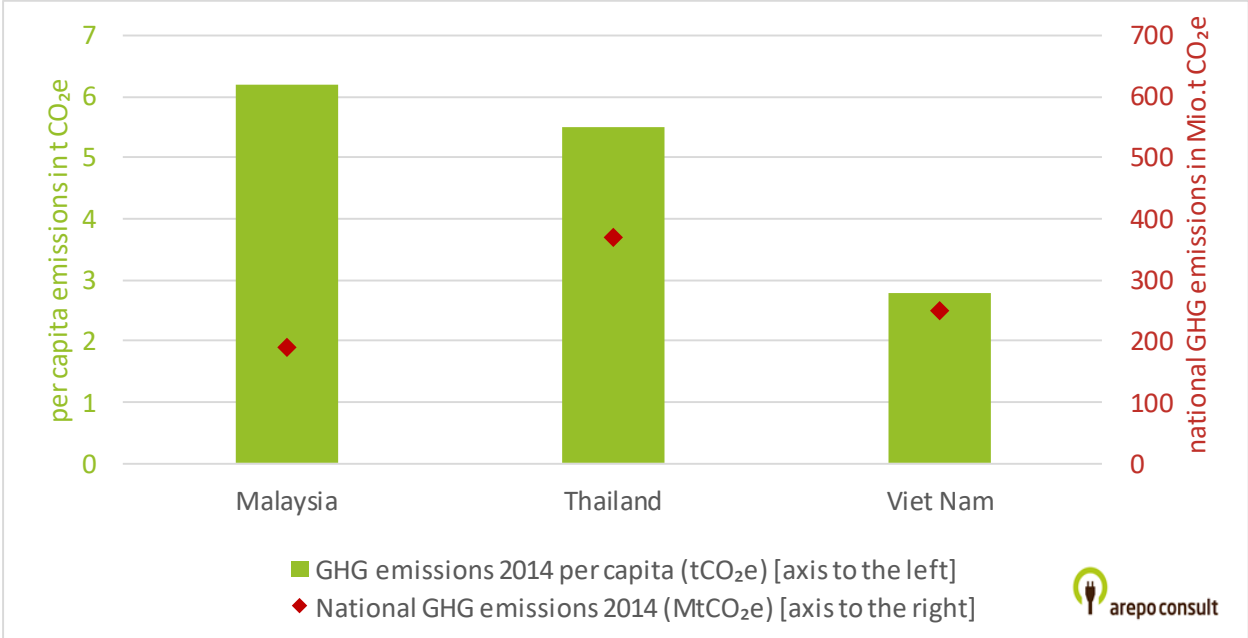
shows the key energy indicators of Thailand in comparison to Viet Nam and Malaysia. GHG emissions of Thailand were 374 Mt CO₂e and 5,47 t CO₂e per capita in 2014 (Figure 2).⁴

Figure 1 Energy demand and energy and electricity consumption in Malaysia, Thailand and Viet Nam in 2014



Source: IEA (n.d.), IEA (2018).

Figure 2 GHG emissions in Malaysia, Thailand and Viet Nam in 2014



Source: ClimateWatch (2018).

⁴ ClimateWatch (n.d.).

Key policy documents of Thailand’s energy policy are the Power Development Plan, the Energy Efficiency Plan,⁵ the Alternative Energy Development Plan, the Gas Plan, and the Oil Plan. Together these plans form the Thailand Integrated Energy Blueprint (TIEB) 2015-2036. Regarding its climate policy, Thailand plans to increase its GHG emissions to 444 Mt CO₂e by 2030; a reduction of 20 % in comparison to a business as usual scenario (unconditional commitment). Thailand has experienced rapid growth in electricity demand, with peak load growing by nearly 50 % between 2005 and 2015, and annual growth in power consumption of an average of 5 % over the same period. The generation and transmission schedule laid out in the Power Development Plan 2015 is based upon an assumption that power demand will continue to grow, albeit at a slower pace of 2.7 % per year.⁶ An overview of key Thai policies and targets in the energy sector is listed in Table 2.

Table 2 Key policies and targets for the energy sector in Thailand

Sector	Policies and targets
Climate change	- Reduce GHG emissions by 20 % from BAU level by 2030, increase to 25 % with enhanced international support
Renewables	- Increase the share of renewables in final energy consumption to 30 % by 2036 - Increase share of renewables-based power generation capacity to 20.11 % by 2036 with technology-specific sub-targets - Increase the share of renewables in transport fuel consumption to 25.04 % by 2036 - Key policy document: Alternative Energy Development Plan 2015-2036 (AEDP)
Fossil fuel	- Key policy document: Gas Plan (GAS) - Key policy document: Oil Plan (OIL)
Efficiency	- Reduce energy intensity by 30 % by 2036 (from 2010 level) - Key policy document: Energy Efficiency Plan (EEP) (2015-2036)
Transport	- Increase electric vehicles to 1.2 million and charging stations to 690 by 2036

Source: OECD/IEA (2017b).

Cost of energy

Fossil-fuel subsidies are prevalent in many parts of the world. In the case of Thailand, fossil fuels are subsidised via the Oil Fund, tax exemptions and caps on retail prices for certain fuels, such as compressed natural gas (CNG) and biofuel blends.⁷ Figure 3 shows the average subsidy rate per capita and the average subsidy rate per product in Thailand in comparison with Viet Nam and

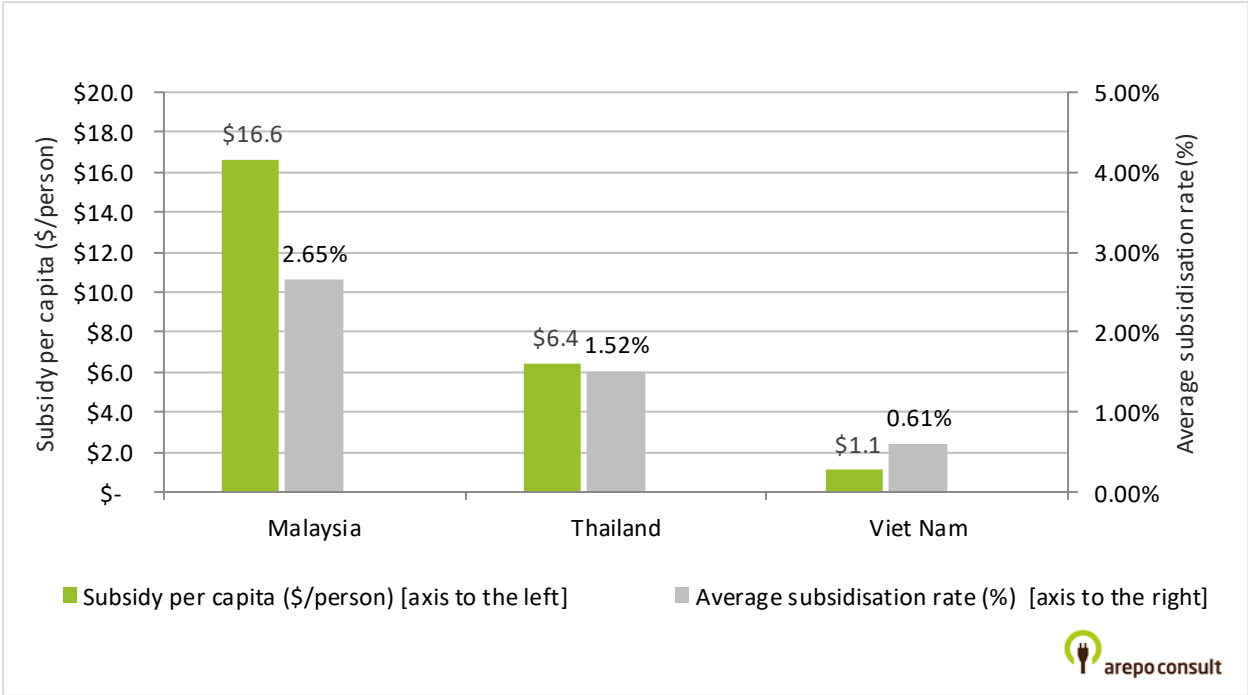
⁵ Formerly called Energy Efficiency Development Plan (EEDP).

⁶ IEA (2016).

⁷ OECD / IEA (2017a).

Malaysia. The average subsidy rate stands at 1.52 % resulting in an average subsidy spending of USD 6.4 / capita. Thailand has made progress in gradually removing electricity subsidies. The Thai Oil Plan 2015-2036 stipulates the intent to allow price reforms of subsidised fuels such as CNG and LPG to reflect the cost of supply.⁸ The policy to provide subsidies to low-income households continues to guarantee energy access to the most vulnerable social groups. In recent years average retail electricity price has been increasing because of higher costs of natural gas.⁹ The assessment of the World Energy Outlook concludes that further tariff reforms would aid in particular energy efficiency initiatives by improving the economic case for many projects.¹⁰

Figure 3 Energy subsidies in Thailand, Malaysia and Viet Nam in 2016 (subsidy per capita and average subsidisation rate)



Source: OECD/IEA (2017c).

Energy efficiency policy in Thailand

Thailand has adopted extensive energy efficiency policies under a comprehensive national Energy Efficiency Plan (2015-2036). The plan includes financial incentives, awareness-raising, EE networking, technical support, standards, and regulation. The key piece of legislation is the Energy Conservation and Promotion (ECP) Act (from 1992 last revised in 2007). The Department of Alternative Energy Development and Efficiency (DEDE) of the Ministry of Energy is responsible for regulation, supervision, promotion, and assistance regarding the Energy Conservation Promotion Act to ensure nationwide actions to save energy.

In 2015, Thailand passed its most recent Energy Efficiency Plan (EEP). Under the EEP, Thailand is implementing a suite of energy efficiency measures that seek to save nearly 90 terawatt

⁸ OECD / IEA (2017b).
⁹ FSE (2017).
¹⁰ IEA (2016).

hours (TWh) of electricity by 2036 and decrease energy intensity by 30 %.¹¹ More than three-quarters of these gains will come from efficiency improvements in the commercial and industrial sectors (37 and 32 TWh respectively).¹² Fuel saving is supposed to range in the amount of 44 ktoe; about 70 % of which is supposed to be achieved by the transport sector. Table 3 presents an overview of the elements of the Energy Efficiency Plan 2015. Of particular importance to the context of the IEE Thailand project are the elements EE 1: Energy Management system in designated factory/building, EE 5: Financial Incentives and EE 9: Human Resources Development, EE 10: Promotion of Public Awareness on Energy Conservation, because they form synergies with the activities of the IEE project. These measures will be discussed below.

Table 3 Elements of the Energy Efficiency Plan 2015

Enforcement	Measure
Compulsory	EE 1: Energy Management system in designated factories/buildings* EE 2: Building Energy Code (BEC) EE 3: Energy Standard and Labelling (HEPS/MEPS) EE 4: Energy Efficiency Resources Standard (EERS)
Voluntary	EE 5: Financial Incentive* EE 6: Promotion of LED (Light Emitting Diode) EE 7: Promotion of EE in Transport Sector EE 8: Research and Development in Energy Efficient Technologies
Complementary	EE 9: Human Resources Development* EE 10: Promotion of Public Awareness on Energy Conservation*

* Important to the context of the IEE Thailand project
 Source: DEDE (n.d.).

Energy Management Systems in designated factories / buildings

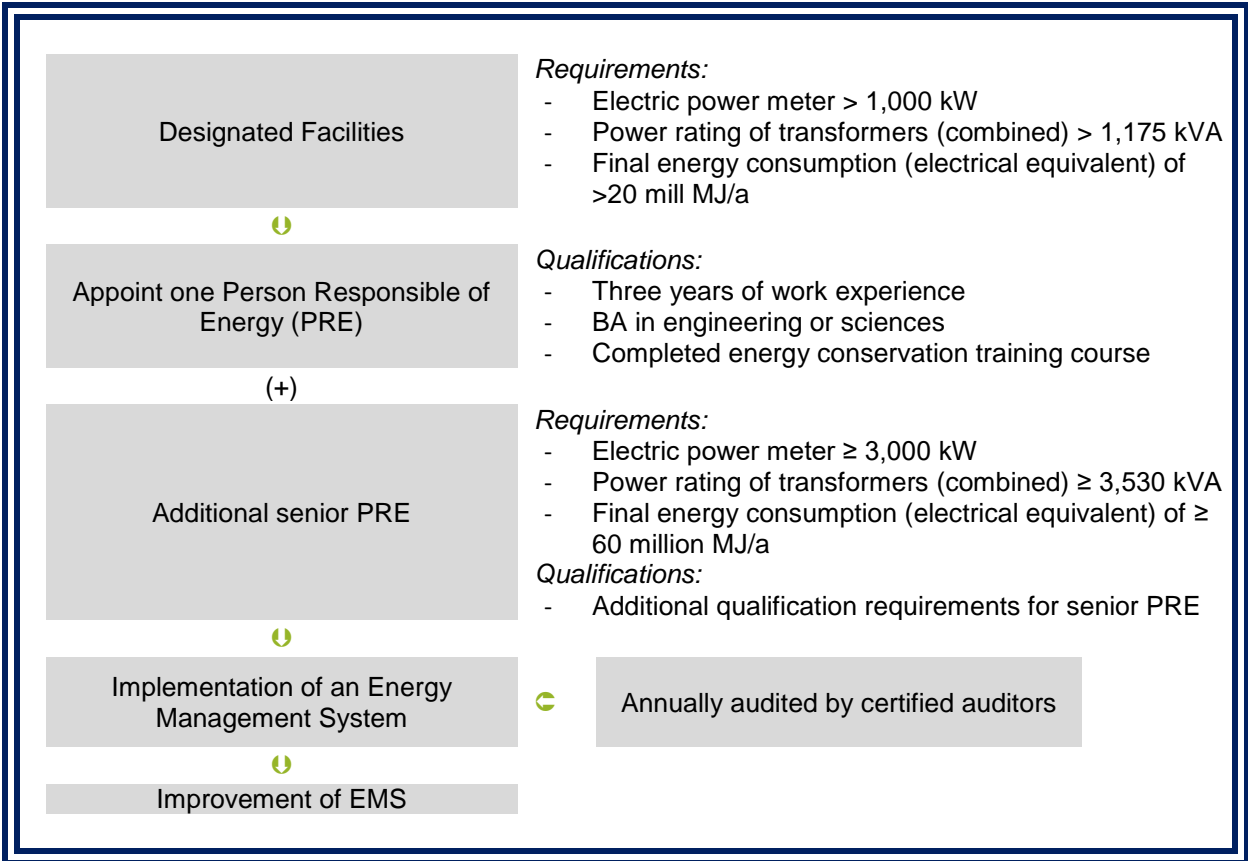
The revised Energy Conservation and Promotion Act introduced energy management systems. Since 2009, designated companies¹³ (with combined installed power meters of > 1,000 kW, power rating of the sum of all transformers > 1,175 kVA or a final energy consumption (electrical equivalent) of > 20,000 GJ / year) need to introduce an EnMS (Figure 4). The designated companies are required to submit an Energy Management Report to DEDE on an annual basis and also need to appoint one or more Persons Responsible for Energy (PRE). The PRE needs to fulfil a series of requirements, among them three years of work experience and a completed energy conservation training course facilitated by DEDE.¹⁴

¹¹ The previous version of the Energy Efficiency Plan (2011) set a target of a 25 % reduction by 2030.
¹² Pichalai (2015).
¹³ Obligations apply to designated factories and buildings. Considering the context of industrial energy efficiency, the description at hand focuses on factories only.
¹⁴ DEDE (2018).

Since 2012, designated companies need to carry out energy management audits according to Thai standards. For this purpose, the designated factory must hire an accredited auditor from an auditor pool. Designated factories must provide the audit reports to the Ministry of Energy.

Measure EE 1 of the Energy Efficiency Plan (2015): Energy Management Systems in designated factories / buildings intends to cover 5,285 controlled factories and 7,260 factory units and is intended to contribute 5,156 ktoe of energy savings.¹⁵ DEDEs responsibility for the ENCON Fund and the designated facilities program make it one of the key actors in the field of Industrial Energy Efficiency.¹⁶

Figure 4 Requirements for designated factories in Thailand



Source: own graph adopted from DEDE (n.d.).

ISO 50001 certification in Thailand

Thailand adopted ISO 50001 as a national standard in 2012 and a series of certification companies are active in Thailand. TISI, a department under the Ministry of Industry, is the accreditation body in Thailand.^{17,18} The TISI website lists two certified companies to carry out energy management certification TUV Nord,¹⁹ and AJA.²⁰ Other companies such as AB, SGS,

¹⁵ Sutabutr (2016).

¹⁶ World Bank (2006).

¹⁷ Accreditation bodies verify that a certification body operates according to international standards.

¹⁸ IAF (n.d.).

¹⁹ TUV Nord (2018).

²⁰ AJA (2018).

BBQI and MASCI also carry out certifications since accreditation by a national body is not a requirement.

ISO 50001 and the EnMS prescribed by the ECP have slightly diverging requirements. There is no regulatory necessity for companies to receive an ISO 50001 certification. In fact, as ISO 50001 certification cannot be used to be exempted from the energy reporting obligations under the ECP, it can appear to companies as a double burden to deal with two (though partially overlapping) reporting schemes. It has been discussed for several years to exempt companies with ISO 50001 certification from the reporting requirement or to accept their ISO 50001 report as being in line with the obligations, but so far such a decision has not been passed.

Financial incentives for energy efficiency

Within the Energy Efficiency Plan measure, “EE 5: Financial incentives” is supposed to contribute 9,524 ktoe to the energy-saving target. With funds from its Energy Conservation Promotion Fund (ENCON),²¹ the Thai government established two key financial mechanisms for supporting energy efficiency and renewable energy development: the Energy Efficiency Revolving Fund and the Energy Service Company Fund.

Energy Efficiency Revolving Fund

Thailand’s Energy Efficiency Revolving Fund (EERF) was established in 2003 and aimed to stimulate energy efficiency investment in large-scale energy consuming industrial sectors. The fund was launched with 2 billion THB, from the ENCON Fund. The EERF engaged the Thailand commercial banks to develop and streamline procedures for appraising and financing energy efficiency projects. It provides loans with 0 % interest rate and 7-year final maturity to local commercial banks as an incentive to encourage the banks to lend to EE projects’ owners / developers and ESCO companies at a maximum interest rate of 4 %.²²

Energy Service Company Revolving Fund

In 2008, DEDE additionally established the Energy Service Company (ESCO) Revolving Fund to encourage private investments in renewable energy and energy efficiency projects which are viable, but seek for project finance.²³ The ESCO Fund aims to address the issue of a lack of equity capital available to SMEs by supporting low-interest rate loans to companies. The fund provides up to 50 % of total equity. In the case of very small projects, it will provide support through equipment leasing. The ESCO Fund also facilitates the sale of Certified Emission Reduction credits (CERs) by energy efficiency and renewable energy owners and investors in the international carbon market. The ESCO Fund received initial capital of THB 500 million from the ENCON Fund.²⁴

Tax Incentives

Furthermore, as a financial incentive, Thailand offers different forms of tax incentives which include exemption of import duties for equipment related to RE/EE, exemption of corporate income tax for eight years for RE/EE manufacturers or businesses and the reduction of corporate

²² Industrial Efficiency Policy Database (2018b).

²³ EfE (n.d.).

²⁴ Industrial Efficiency Policy Database (2018a).

income tax for businesses that improve their energy efficiency or utilize renewable energy of up to 70 % of investment costs.²⁵

Human resources development

DEDE runs the Bureau of Energy Human Resource Development (BEHRD), a training centre for the Person Responsible for Energy and free-of-charge basic training courses on energy efficiency to the industry. BEHRD offers in-person courses as well as E-Learning courses. mation

Table 10 in Annex VI lists examples of the courses and their content. DEDE temporarily also offered a training course dedicated to ISO 50001.

Until 2017 - supported by the IEE project - TISI offered training on EnMS within the Training of Lead Consultancy (TLC) project.

The Department of Industrial Promotion (DIP) ran the Total Energy Management program (TEM) since 2004. The TEM program provided assistance to SMEs to carry out energy audits and train factory personnel in general housekeeping.

Outside of public course offers, factories interested in training can also receive it from the certification bodies as individual services or as part of the certification package. At the time of writing, participation in a training course was expected to cost between 5,000 to 6,000 baht.

Promotion of public awareness on energy conservation

The Ministry of Industry is carrying out the Prime Minister Awards of the Energy Sector. Another Energy Award started in 2000 as an annual activity organized by DEDE.²⁶ This award aims to encourage energy conservation leadership in enterprises, applaud companies and people of excellence in energy efficiency and renewable energy, as well as promote projects and technologies. The public event for awards is hosted by DEDE every year. The winner of the awards will receive recognition from the prime minister and ministerial-level officials.²⁷

1.3. Overview of the project

The objective of the IEE project is to promote industrial energy efficiency through adoption of ISO-based energy management standards and system optimization approach, for improvement of energy performance of industries to make their operations more reliable and competitive.²⁸ This project was developed under the parent program “Reducing Industry’s Carbon Footprint in South East Asia through Compliance with an Energy Management system (ISO 50001).”

The project consists of four components:

- Component 1: ISO compliant energy management systems: This component is designed to increase the national awareness on ISO 50001, to deliver the ISO 50001 training to

²⁵ Sinsukprasert (2010).

²⁶ Funding support for the awards comes from the ENCON Fund. The awards are classified into five categories: i) RE projects; ii) Industry and building energy efficiency improvement; iii) Innovations; iv) Outstanding individuals and team performance in EE in plants/building; and v) Support for energy conservation. Industry and building energy efficiency improvement (Category ii) was recently split into a competition for SMEs and one for large enterprises to allow SMEs a fair chance in the scheme as well.

²⁷ Industrial Efficiency Policy Database (2018c).

²⁸ GEF (2010).

national experts, factory management and personnel, and to establish a peer-to-peer network among industrial enterprises.

- Component 2: Industrial energy systems optimization: The energy systems optimization training consisting of steam, compressed air, fan, and pumping systems will be delivered to national experts, factory management and personnel as well as the manufacturers, vendors and suppliers.
- Component 3: Enhancement of industrial energy efficiency financing capacity: The industrial energy efficiency financing capacity will be enhanced through the training for banks/financial institutions and factory management.
- Component 4: Implementation of energy management and systems optimization projects: To increase the adoption of energy management standards and systems optimization, the project will facilitate the implementation of ISO 50001 and energy systems optimization projects in the selected factories.

The activities were directed at seven industrial sectors: 1) food and beverage; 2) textile; 3) pulp and paper (included later); 4) rubber and plastic; 5) chemical and chemical product; 6) basic metal; and 7) non-metallic. Participants for expert training were factory personnel (managers and engineers), independent consultants, academia and government officials. Besides EnMS training (component 2), the project offered system optimization training (component 2) for four technologies: compressed air, fan, steam, and pumping systems.

Figure 5 shows the structure of the IEE project Thailand.

Figure 5 Structure of the IEE project Thailand



Source: PMU (2016).

The project is a full-size project with a total project volume of USD 19,265,000. According to the original budget, 19 % (USD 3,620,000)²⁹ of the costs were supposed to be financed by donor funding and 81 % by co-financing (USD 15,645,000) (compare Figure 16 in Annex VI).³⁰

The project started on March 6th, 2012 and was expected to end on March 5th, 2017. It eventually ended in July 2018. The UNIDO Project Manager (at UNIDO HQ) oversaw project implementation and monitoring. The day-to-day project management was the responsibility of the Project Management Unit (PMU), headed by a National Project Coordinator. The DIP designated one of their high-level officers to act as National project Director (NPD) in order to guide the PMU in the implementation of the project.

The Project Steering Committee (PSC) consisted of the following parties:

1. Department of Industrial Promotion (DIP)
2. Thai Industrial Standards Institute (TISI)
3. Department of Alternative Energy Development and Efficiency (DEDE)
4. Department of Industrial Works (of Ministry of Industry) (DIW)

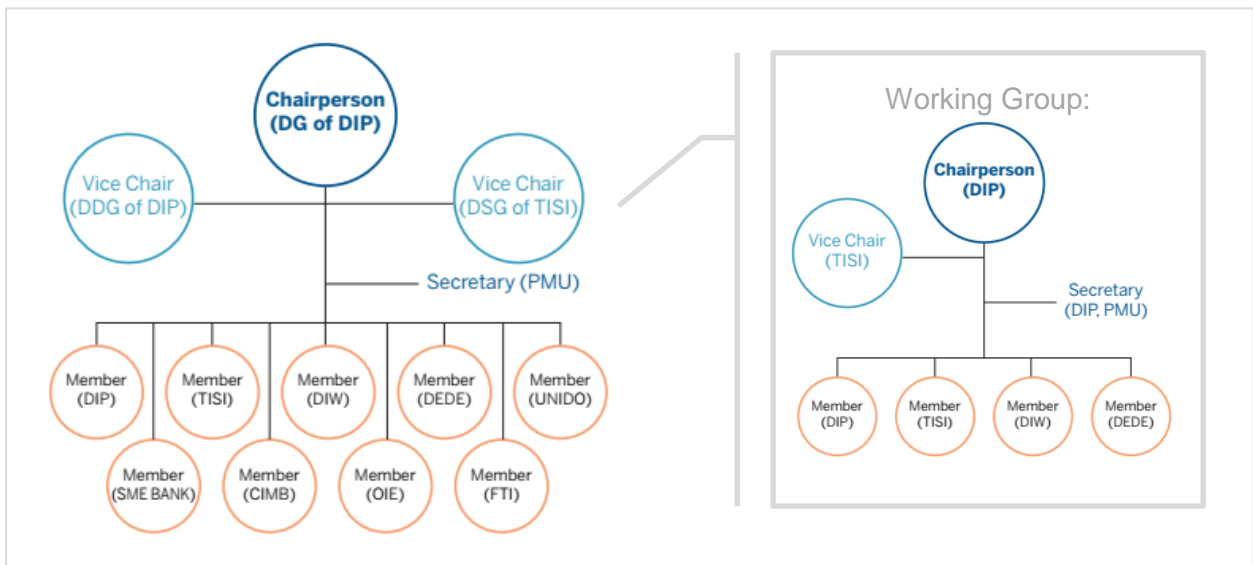
²⁹ Additionally, GEF provided USD 100,000 as a project preparation grant.

³⁰ GEF (2010a).

5. United Nations Industrial Development Organization (UNIDO)
6. CIMB Thai
7. Office of Industrial Economics (OIE)
8. Federation of Thai Industries (FTI)
9. SME BANK.

The PSC met five times (2012, 2013, 2014, 2015, 2017) during the project duration of six years (2012-2018). The Steering Committee formed a smaller working group with a fewer number of members (see Figure 6).

Figure 6 Structure of Project Steering Committee (left) and Working Group (right)



Source: PMU (2018).

Mid-Term Review

The Mid-Term Review was carried out by a team of independent reviewers in the period from January 2015 to March 2015. Project performance ratings are as follows:

- Relevance: HL (Highly relevant)
- Design: HS (Highly satisfactory)
- Effectiveness: S (Satisfactory)
- Efficiency: HS (Highly satisfactory)
- Sustainability: L (Likely)

Further details can be referred to in the MTR report (April 2016).

1.4. Evaluation methodology

The Terminal Evaluation was conducted in accordance with UNIDO Evaluation Policy.³¹ The evaluation was carried out using a participatory approach that sought to inform and consult key stakeholders of the project.

Arepo Consult was commissioned by UNIDO to conduct the Independent Impact Evaluation of UNIDO's Industrial Energy Efficiency-Related Programmes. As part of this impact evaluation at programme level, Arepo Consult provided the team leaders of the evaluation teams for four terminal project evaluations: IEE-Egypt, IEE-Indonesia, IEE-Iran and IEE-Thailand. The team leaders also work on the impact evaluation of the programmes as a whole.

The evaluation team adopted a theory of change approach to assess the causal links between project activities, outcomes and outputs. The team conducted an assessment of the extent to which the project contributed to the conditions necessary to achieve the broad adoption of energy efficiency management systems based on ISO 50001 and more widespread incorporation of a systems optimization to maximize energy efficiency.

A combination of methods was used to deliver evidence-based qualitative and quantitative information, from diverse sources including: desk studies and literature review, individual interviews, focus group meetings, survey data collected by the PMU and feedback review.

The desk review involved a review of the original project document, monitoring reports (such as progress and financial reports, and Mid-Term Review report) and notes from the meetings of the steering committee. The full document list can be found in Annex III.

The evaluation field visit took place from May 30th to June 8th, 2018. The evaluation team was composed of an international evaluation consultant, Sarah Rieseberg, and a national evaluation consultant, Tharee Kamuang. A staff member from UNIDO's Independent Evaluation Division, Müge Dolun, accompanied the team on the trip.

During the country mission, 13 meetings were carried out in which interviews were performed with the stakeholders listed in Annex IV.

1.5. Limitations of the evaluation

The team was only able to visit a limited number of companies for interviews – three in total – when compared to the large number of pilot companies involved. To collect the feedback from a more representative sample of project participants would require a more quantitative form of data collection via surveying project participants.

A further limitation was that as a result of lack of availability, the evaluation team could only present the preliminary findings and conclusions to the PMU but not to national stakeholders to receive feedback.

1.6. Theory of Change

The IEE project was designed to: i) increase awareness and reinforce Thailand's efforts on the implementation of energy management systems based on ISO 50001. This is to urge industrial enterprises to integrate EE as part of the management cycle for the realization of continuous

³¹ UNIDO (2015).

energy savings, and ii) incorporate industrial energy systems optimization as a means to maximizing energy savings and reducing production costs.³² The project logframe includes four project components with 13 outputs to be achieved by the project:

- **Component 1: ISO compliant energy management systems**
 - Output 1.1: Training material and tools on energy management developed
 - Output 1.2: National awareness campaign launched on ISO 50001
 - Output 1.3: National experts/factory personnel trained on energy management systems
 - Output 1.4: Peer-to-Peer network between industrial enterprises created and operational
- **Component 2: Industrial energy systems optimization**
 - Output 2.1: Training materials, software and tools on systems optimization developed
 - Output 2.2: National experts / factory personnel trained on i) optimization of steam, ii) compressed air, iii) fan and iv) pumping systems
 - Output 2.3: Equipment vendors / suppliers trained on systems optimization
- **Component 3: Enhancement of industrial EE financing capacity**
 - Output 3.1: Harmonized project evaluation criteria
 - Output 3.2: Capacity of banks / FIs enhanced on EE projects financing
 - Output 3.3: Training material developed, and industry managers trained on the development of financial proposals
- **Component 4: Implementation of energy management and systems optimization projects**
 - Output 4.1: Energy management systems implemented
 - Output 4.2: Documented system optimization demonstration projects
 - Output 4.3: Recognition program developed and implemented

Based on the logframe, a theory of change was developed by the evaluation team which connects activities leading to outputs. Since the project logframe did not include outcomes, the theory of change suggests a series of outcomes which connect outputs and impacts (left to right in Figure 7).

Whilst the thematical clustering chosen in the logframe (component 1-4) is useful for the workflow, to track the logic chain from outputs to impacts the evaluation team suggests tracking the activities of the different target groups to understand how the project intends to accelerate the uptake of EE.

The evaluation identified eight different target (sub)groups, which the IEE project is addressing, depending on the group, different outcomes follow. To better guide the reader through the TOC (Figure 7) colour and pictograms are used for the different target groups:

³² GEF (2010).

- Primary stakeholder: Energy-using enterprises (with varying degrees of intervention depth by the project) (🏭), with the subgroups:
 - i. Wider economy (🏭)
 - ii. Light-intervention companies (🏭)
 - iii. Deep-intervention companies (🏭)
- Technical services and equipment supply chain (✂️), with the subgroups:
 - iv. Independent consultants and service professionals (👤),
 - v. Equipment supply chain (✂️)
 - vi. Academics (🎓)
- Finance community (💎):
 - vii. Banks and financial institutions (🏦)
- Policy and standards communities (🟦):
 - viii. Technical standards community (🏢)

Project Outputs

Analysing the outputs, these were clustered in the TOC-diagram as follows (on the left of Figure 7):

- *Direct technical assistance (OP 4.1,4.2):* Implementing Energy Management System (EnMS) pilot/training projects (OP 4.1), implementing Systems Optimization (SO) implementation pilot/training projects (OP 4.2)
- *Capacity Building:*
 - *Awareness, information, networks & recognition:* general IEE awareness-raising (OP 1.2), IEE information dissemination, peer-to-peer networks (OP 1.4), recognition (OP 4.3)
 - *Technical training (OP 1.2, 2.1, 2.3):* EnMS training (materials) – users, SO training (materials) – users, EnMS training (materials) – experts, SO training (materials) – experts
 - *Financing development:* Financial awareness and capacity (3.2), financial training (OP 3.3), harmonized project evaluation criteria (OP 3.1)

Project Outcomes

🏭 Stakeholder group I: Energy-using enterprises 🏭🏭🏭

While the project works with many different target groups, only the primary group (🏭), the energy-using enterprises can achieve actual energy efficiency savings. On intermediate outcome level, the project improves the inhouse capacity of the companies it engaged with. On a higher outcome level, the underlying project logic of the IEE project is that all targeted audiences multiply their knowledge to other factories and actors. Energy-using enterprises themselves are an important multiplier too. They might spread their experience and knowledge to other factory sites, within their company group or even with outside companies.

Outcomes of the interventions targeting the energy-using enterprises

Intermediate outcomes:




- ① Partner enterprises apply EE approaches and implement EE measures – with direct impacts, and share the results within their company group, companies in the sector and the wider economy. Auxiliary outcomes: demonstration/confidence and practical training venues.
- ② Industry top management aware, informed, motivated and committed to implementing EnMS/SO/IEE activities approving: training staff, hiring consultants, investing in better equipment, and applying for financing based on improved business and financial proposal
- ③ Sufficient factory engineers/technicians qualified (at user level) to implement EnMS/SO/IEE activities carrying out: training staff, hiring consultants, investing in better equipment, and applying for financing based on improved business and financial proposal

Higher-level outcome:


- Outside of the companies in contact with UNIDO other companies copy the show cases and replicate them in their own facilities. Industrial enterprises implement EnMS / implement SO/ train staff / hire consultants / invest in better equipment / apply for financing based on improved business plans and financial proposals,

All other stakeholders addressed by the UNIDO project either create framework conditions, such as regulatory work, offer credit lines; or they directly offer their services to industrial consumers.

* Stakeholder group II: Technical services and equipment supply chain

Some target groups such as independent consultants () will not carry out energy efficiency measures directly but merely work as knowledge disseminators. The same applies to equipment suppliers () who are more likely to promote new (energy efficiency-related) services and equipment to their customers. Academics, researchers, and lecturers () work as multipliers of information since they train students or factory personnel.

Outcomes of the interventions targeting the technical services and equipment supply chain

- ④ Equipment suppliers and vendors () improve customer support, offer energy-efficient technologies and adapt their assortment to include more high-EE products.
- ⑤ Sufficient vendors qualified (at expert level) to offer/service equipment to factories implementing SO/IEE activities (auxiliary outcome: serve as champions/influencers for IEE issues).
- ⑥ Academics and educators teach EnMS/SO/IEE topics, in stand-alone courses or as part of university or technical school curricula.

◆ Stakeholder group III: Finance community

If banks and financial institutions offer better conditions to energy-using enterprises these can more easily access financing.

Outcomes of the interventions targeting the finance community

- ⑦ The financial community offers IEE-appropriate credit lines, guidelines and analytical capacity to offer sufficient external financing – easily-accessible at attractive terms – to factories implementing EE activities.

● Stakeholder group IV: Policy and standards communities

Within the technical standards community improved accreditation and certifications bodies improve the quality of services supplied to energy-using enterprises.

Outcomes of the interventions targeting the policy and standards communities

⑧ **Suggested intermediate outcome:** Improved quality of certifications bodies, Technical standards community has capacity to market/maintain EnMS standards.

Summary of project outcomes

Due to improved inhouse expertise and an improved supportive framework, energy-using enterprises carry out EE works, implement EnMS / SO, train staff, hire consultants, invest in better equipment apply for financing (intermediate outcomes). The improved knowledge base replicates in the market via replication pathways and reaches more companies that had not been directly involved with the UNIDO project (higher-level outcome).

Project impacts

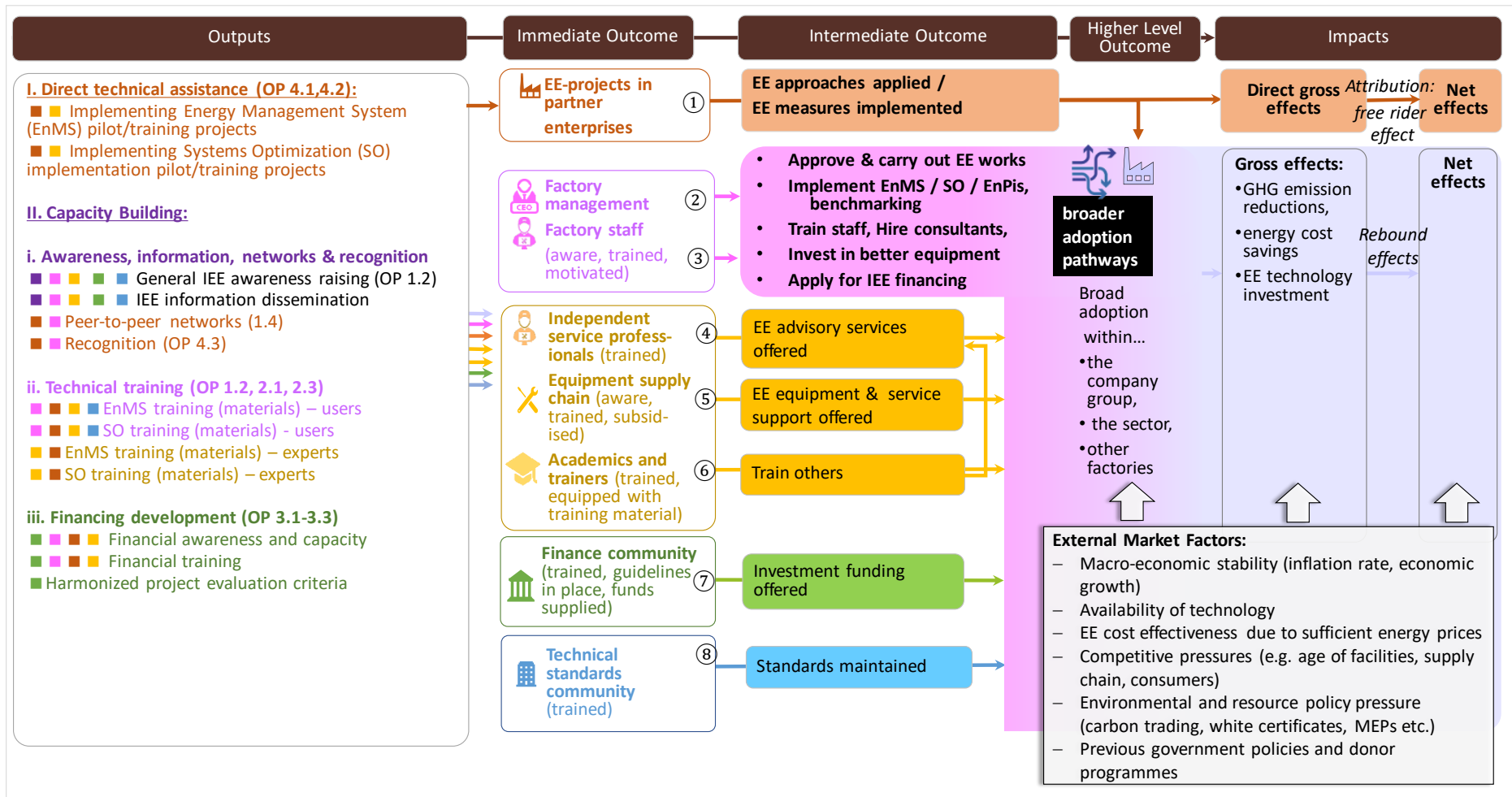
On the impact level, as soon as energy-using enterprises have implemented energy efficiency measures, they achieve GHG emission reductions. The project monitoring of the project in question only covers energy and GHG emission reductions but companies also accomplish resource consumption reductions, improved air quality, create income effects, increased industrial competitiveness and economic growth.

It should be noted though that these impacts are gross and that different types of rebound effects, such as increase in production and income effects (see textbox 1), reduce gross savings to net savings and net effect.

Textbox 1: Rebound Effects

Improved energy efficiency can have multiple unintended consequences that have the potential to erode much of the anticipated energy savings. Efficiency increases oftentimes reduces product or service prices, which can in turn ramp up consumption, thus partly cancelling out the original savings. This is known as **direct rebound effect**. To give an example if product prices for plastic products decreases, use of plastic packaging material might increase negating the energy savings by increased production. **Indirect** or **second-order effects** are resulting from the fact that lower production costs have an economic growth effect. Consumers can invest the savings in new, possibly even more energy intensive consumer goods, e.g. a plane ticket, in this case the efficiency gains backfire via the economic growth effect and net emissions increase.

Figure 7 Theory of Change of the IEE project: Output to Impact level



Source: Own diagram.

2. Project's contribution to development results – Effectiveness and impact

2.1 Project's achieved results and overall effectiveness

A project's *results* include direct project outputs, short- to medium-term outcomes, and progress toward long-term impact including global environmental benefits, replication effects, and other local effects.³³ Effectiveness refers to the extent to which a project's actual outcomes commensurate with the expected outcomes.

Achievements on output level

For its 13 outputs the project set out to achieve 21 output targets. Figure 9 illustrates the target achievement of those outputs that are quantifiable in terms of “number of...”.

Table 11 in Annex VI lists the targets and achievements for all indicators. Almost all targets were fully achieved or overachieved with additional outputs being produced. A series of targets shall be discussed in more detail in the following sections.

Output 1.2. National awareness campaign

The PMU practiced adaptive management and diverted from certain project design aspects in response to changes in the project's environment. The output “*National awareness campaign launched on ISO 50001*” was carried out to a lesser degree than originally planned to prevent duplication with a road show carried out by TISI at the same time on the same subject.

Outputs addressing capacity building (1.1., 1.3., 2.1., 2.2., 2.3, 3.1, 3.2, 3.3)

A key result of the IEE project is the training of national experts, factory management and personnel. For the outputs 1.1., 1.3., 2.1., 2.2., 2.3, 3.1, 3.2, and 3.3 (see Table 11) which all provide capacity building and training, the project carried out 104 training and awareness workshops. IEE services differed from other training offers, particularly the DEDE EnMS training course, in that the content was more comprehensive, and it was designed as a combination of theoretical and practical exercises. The project was distinct from the competitors providing training to the industry by using a system efficiency approach thus moving the participants' perspective from the component to the system level.

Companies formulated 200 implementation plans and 50 companies introduced energy management systems. In total, 1,048 factories participated in the project's activities. The 2007 Industrial Census (National Statistical Office) listed for the whole industrial sector 26,100 medium and large factories. Based on this total of the industry, 4 % participated in the IEE activities. Having in mind that acquisition required a far greater number of company contacts than the number of companies which sent their staff to the training, it can be assumed that IEE was in touch with a far greater number of factories.

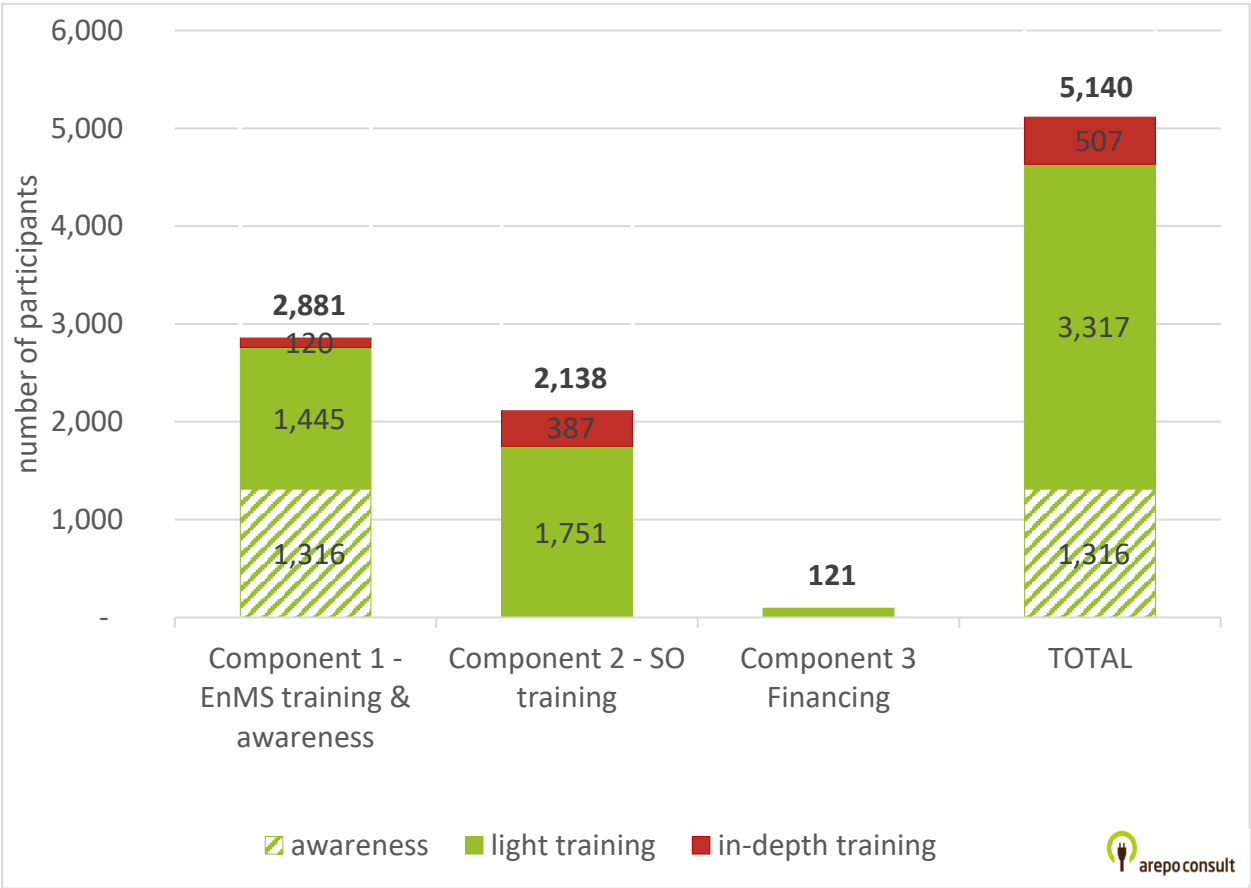
The project succeeded in training 87 national experts: the EnMS course was passed by 62 and the SO course by 48 of the experts, with several experts passing more than one course. The achievement rate for the target to train 50 national SO experts reached 96 % because a significant share of experts did not attend the final examination.

³³ GEF (2010b).

It was described as particularly challenging to reach the target number of national experts passing the final exam, because drop-out and failure rates varied course by course. The pumping system course was confronted with an added difficulty to find suitable training sites to deliver a final report and the time lapse between the final training day and the examination date was quite long.

As is shown in Figure 8 the project counted 5,140 participants in its activities. 26 % participated in awareness-raising activities, 65 % in light training and 10 % in in-depth training.³⁴

Figure 8: Participants in project activities



Source: own compilation.

Output 1.4. “Peer-to-peer network between industrial enterprises established and operated”

The IEE project produced a “basecamp website” and used it as a peer-to-peer network. The project also established a LINE group³⁵ which will still be used by the national experts after the project. PMU only established the peer-to-peer-network for national experts. The pilot factories were not included and did not use it to spread their experiences via factory energy management implementation plans. This peer-to-peer network was not perceived by the PMU as an appropriate way of knowledge sharing among pilots, partially because of data security concerns.

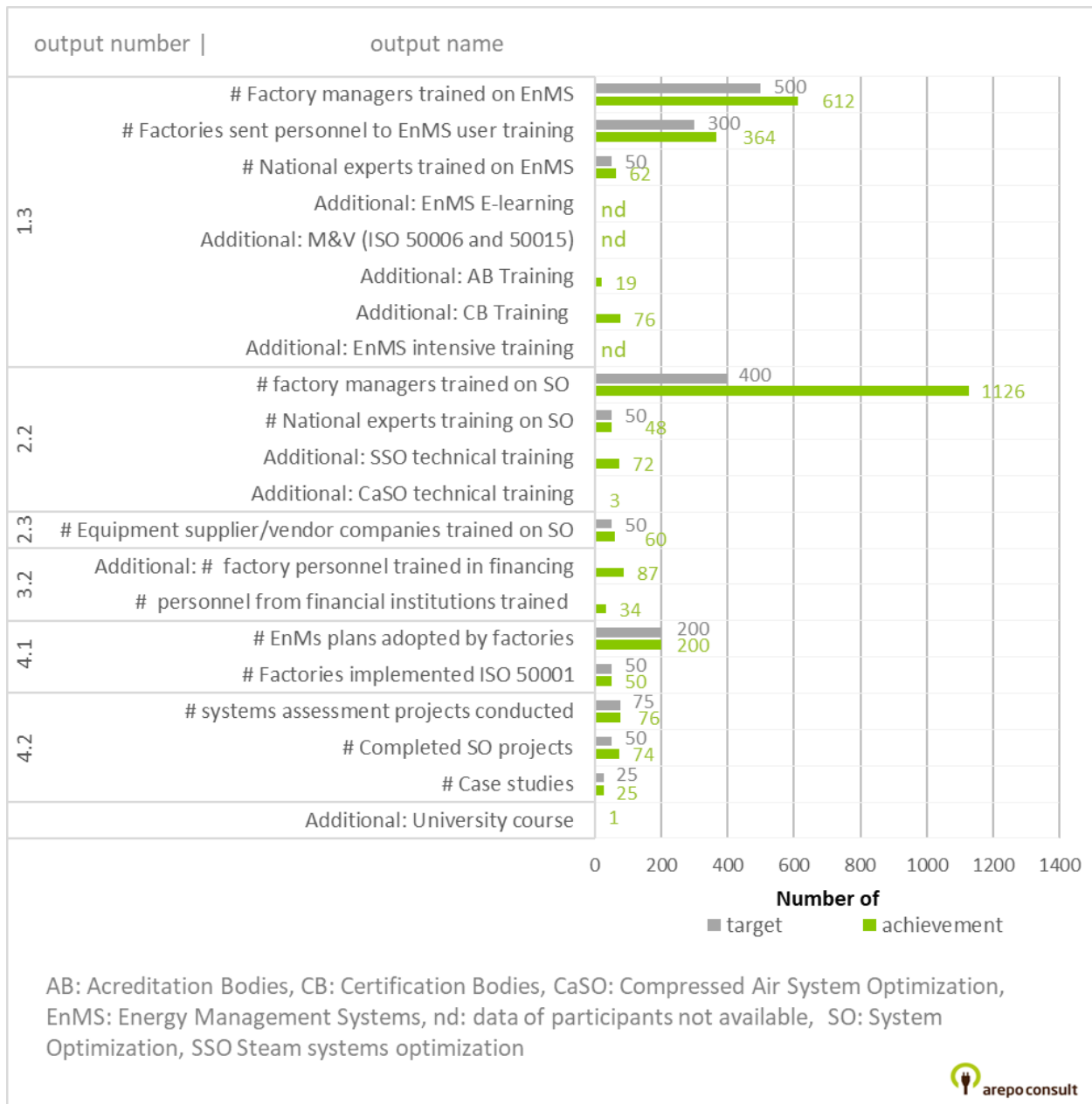
³⁴ Awareness training was defined as including manager awareness-raising, light-training included 2-day user trainings, finance, vendor SO training, AB & CB training and in-depth training included SO / EnMS Expert, SO technical training, EnMS 4 days intensive and biomass boilers.

³⁵ LINE is a messenger service used in Thailand comparable to WhatsApp.

Additional Outputs – exit strategy

In addition to the original project document, the midterm review had suggested the development of a university training course as a form of exit strategy. The UNIDO prepared such a training course in the second half of the project. This constitutes an additional output which can be requested by universities from UNIDO HQ. At the time of the evaluation, the university course was awaiting approval by Thai government offices, among them the Ministry of Education. The evaluation team could therefore not assess to what degree the course is being taken up by universities or other teaching institutions.

Figure 9 Achievement rate of quantifiable output targets



Source: own compilation based on data from PMU (2018).

Achievements on outcome level

The outcome statements in the project document were not operationalized into indicators and targets to measure the project's result on this level. Since there were no outcome indicators formulated, there is no straight forward way to assess the degree to which the project has succeeded in achieving its objectives: *the promotion of industrial EE through adoption of ISO-based energy management standards and system optimization approaches for improvement of energy performance of industries, so as to make their operations more reliable and competitive.* The TOC developed by the Evaluation Team includes a list of suggested outcomes (section 1.6), but data collection could not be carried out retroactively.

Based on the interviews the Evaluation Team concludes, that the project achieved the sensitization of participants on its activities on energy efficiency and equipped them with key skills

to move forward to implementation. Stakeholders interviewed were positive about the project's contribution to the development of energy efficiency in Thailand. One stakeholder stated that "*The IEE provided new techniques for replacing inefficient equipment and introduced course participants to regression analysis*". IEE was perceived as a good model for the industry to learn about energy efficiency.

Quality of results

The PMU collected feedback from course participants on the quality of the course they participated in. For this purpose, the PMU developed its own survey instrument.

Figure 17 to Figure 20 in Annex VI are based on the survey undertaken for the two-day EnMS user training (activity number 1.3.1). In this survey, the PMU asked course participants the following questions:

3. Did the training material provide sufficient details? (Figure 17 in Annex VI)
4. Did the trainer's presentation help you understand the course content? (Figure 18 in Annex VI)
5. Can you use the training content at your factory? (Figure 19-in Annex VI)
6. Have you implemented an EnMS at your factory site? (Figure 20-in Annex VI)

The first three questions were answered by 80 % or more of respondents with "yes". The factual question No. 4 "Have you implemented an EnMS?" received 54 % affirmative answers

The yes / no / "not sure" answer options allowed little room for differentiation but serves as an indication that course participants were generally satisfied with the quality of the training they received.

The evaluation team interviewed several national experts and participants in training activities, both in focus groups and individually. The project offered SO training for steam, compressed air, pumping and fan systems. Several experts stated that industrial chillers and cooling would have been important to cover under SO training, particularly in the food sector. The overall direct feedback was very positive with training participants stressing that they gained a new perspective and benefited a lot from the combination of a theoretical and a practical learning approach. This feedback is broadly in line with the survey results (Figure 17 to Figure 20 in Annex VI).

Attribution of results to project outputs

The following external factors have been identified by the evaluation team as relevant for driving industrial energy efficiency in Thailand:

- 1) Endogenous energy efficiency (business as usual), e.g. due to standard replacement cycles of equipment
- 2) Energy efficiency policy in factories
- 3) Market push: either in the customers' market or obligations in the host countries of parent companies
- 4) Thai energy efficiency policies

The efforts of the IEE project to improve energy efficiency are aligning with the other drivers of energy efficiency. These efforts mutually support one another and, in many cases, cannot – not even by companies themselves – be ranked according to their importance. Rather, all efforts

together create the environment to set the ball rolling. Certain factors can be described as crucial in the case of IEE Thailand.

Many of the companies that the project is targeting are designated companies with a Person Responsible for Energy, which means that the Thai policy framework obliges these companies to have trained energy managers and to undertake regular energy reporting and audits. This regulation has been put in place in 2009 at the design phase of the IEE project. The compulsory obligations created a fertile ground for further energy efficiency improvements. From this starting point, the IEE project improved the human capacities.

The savings measured by the project are gross savings, which means they have not been corrected by factors of autonomous energy efficiency improvements (baseline data) and free-rider effects. In the interviews, the national experts expressed the notion that if they had not received training with UNIDO they would not have participated in an alternative training by a competitor. Anecdotal evidence therefore indicates a relatively low free-rider effect, but it can be assumed that in such a mature policy framework “autonomous” energy efficiency improvements are high and need to be deducted from the savings to arrive at the real savings attributable to the project. Sources for factors of historic autonomous energy efficiency improvements can be market studies and statistics. Bottom-up tools are company surveys to assess to what degree interventions had been partially or fully previously planned and by how many years investments have been moved forward.

Space for increasing effectiveness

As can be seen in Table 10 in Annex VI, the energy efficiency training offered by the Bureau of Energy Human Resource Development shows certain overlap with the trainings offered by the project. The project might have benefitted from a closer cooperation on the training issues with DEDE and a mutual exchange of its curricular and training approach with the DEDE training centre, BEHRD. According to the original project design, DEDE was only involved in the financial component 3. A closer cooperation from the beginning of the project also in component 1 and 2 might have increased the long-term impact of the project. Such cooperation was attempted by the project, the institutional project design and DEDE’s role there in prevented to fully take advantage of cooperation options.

Project target groups

According to the project document, the seven targeted industrial sub-sectors were selected after discussions with the lead government counterpart, based on the country needs and priorities in terms of enhancement of the industrial sector competitiveness and other selection criteria.³⁶ Since sectoral foci are among other things intended for improved training participant acquisition, like better word-of-mouth-recommendation or better outreach of factories and promotion of case studies, such replication pathways require a more careful monitoring to potentially optimize them.

³⁶ According to the project document, other selection criteria were the sub-sectors’ impact on GHG emission mitigation, their capacity to respond to energy management opportunity, their willingness to participate and invest, their share of energy consumption and their current situation concerning energy management and system optimization, the replication factor and the importance of the sector on the national economy.

Summary of Effectiveness

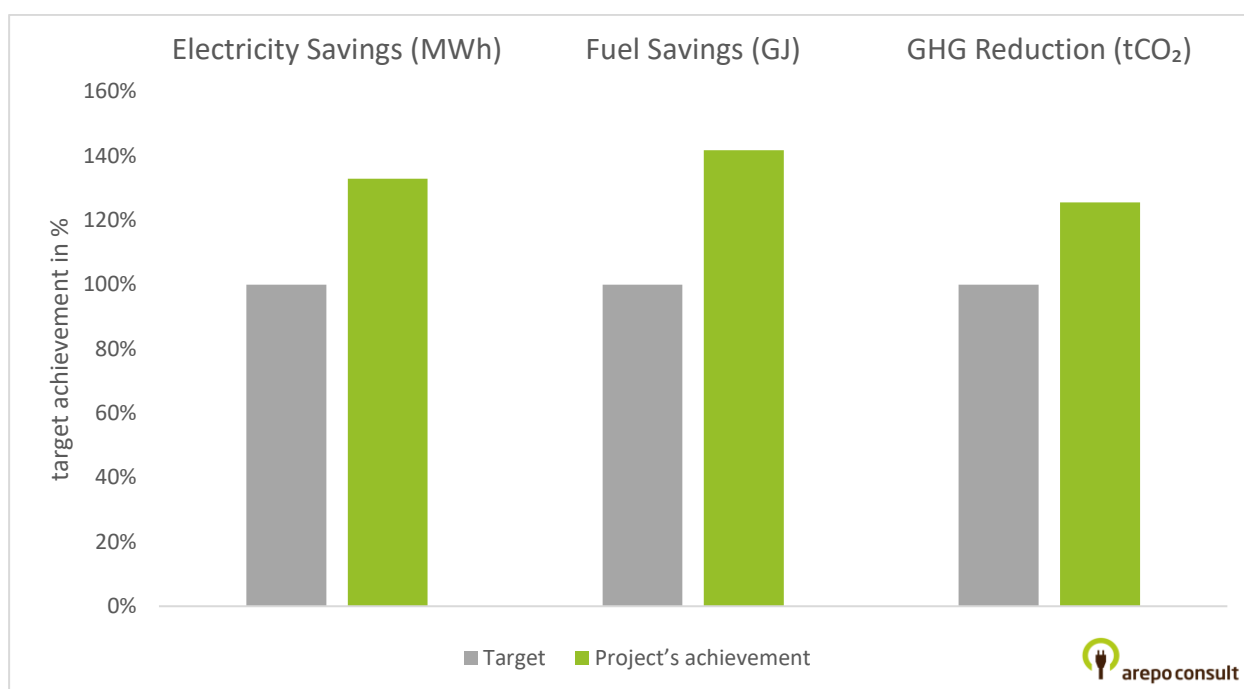
Evaluation Criteria C2) Effectiveness	
<ul style="list-style-type: none"> - What are the main results (mainly outputs and outcomes) of the project? What have been the quantifiable results of the project? - To what extent did the project achieve their objectives (outputs and outcomes), against the original/revised target(s)? - What are the reasons for the achievement/non-achievement of the project objectives? - What is the quality of the results? How do the stakeholders perceive them? What is the feedback of the beneficiaries and the stakeholders on the project effectiveness? - To what extent is the identified progress result of the project attributable to the intervention rather than to external factors? - What can be done to make the project more effective? - Were the right target groups reached? 	
Summary of findings	
<p>The project carried out most of the activities it set out to and achieved or even overachieved almost all of its output targets. Based on the results showed in capacity building of experts and with companies, the first two components are rated as 'highly satisfactory'. The project implementation in component 3 is rated as "satisfactory". Component 4 is rated as 'highly satisfactory'.</p>	
Rating	
C2) Effectiveness	Satisfactory

2.2 Progress towards impact

2.2.1. Achievements on impact level

The project document sets out an overall objective to *“promote energy efficiency in the industries through introduction of ISO energy management standard incorporating industrial system optimization, to make its operations more reliable and competitive.”* This objective is tracked with three indicators: measurable reductions in i) electricity, ii) fuel consumption, and iii) GHG emissions. The targets on impact level of the project were defined as gross savings of 83,712 MWh electricity, 1,914,142 GJ fuel savings and 196,756 t CO₂ GHG emissions. The project overachieved on its targets by 133 %, 142 % and 126 % respectively (see Figure 10).

Figure 10: Target achievements

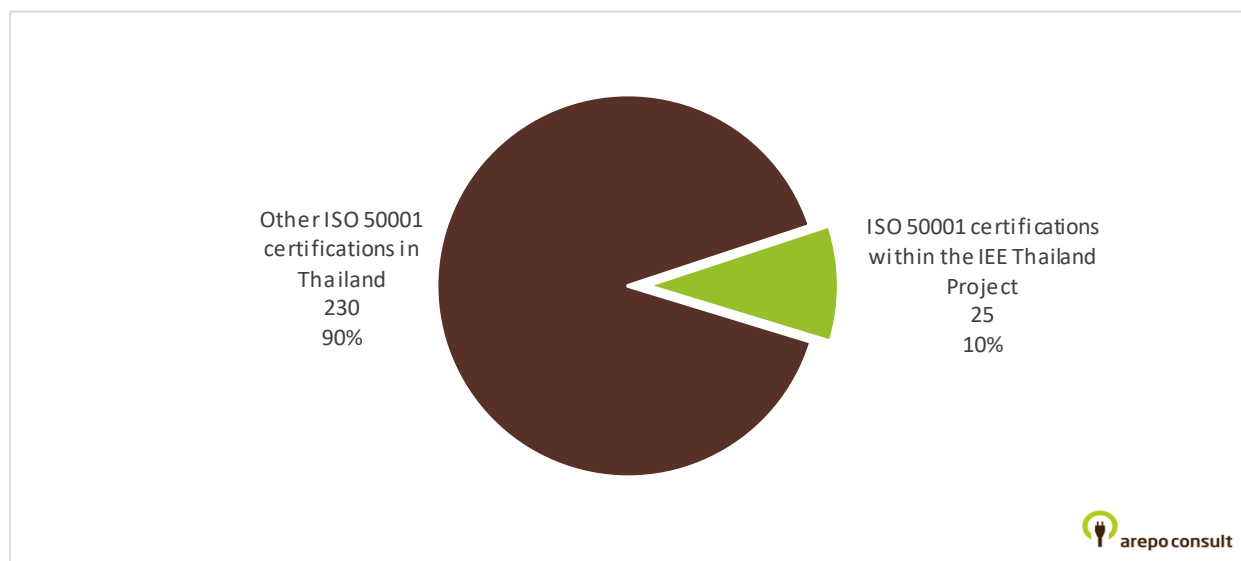


Source: own graph.

The impact indicators were not designed to track a market transformation beyond savings achieved by immediate project interventions; which limits the ability to track whether the adoption of ISO-based energy management standards and system optimization approaches are more widespread in the Thai industrial sector than prior to the project.

One option to track the adoption of ISO 50001 retroactively in Thailand is by relying on ISO 50001 certification data, the limitation of this indicator is that it only tracks certifications but not all those companies with an equivalent -but not certified- standard in place. UNIDO was by many interviewees described as a major driver for ISO 50001 certifications in Thailand and contributed to 25 certifications within the IEE project. Figure 11 shows the number of ISO 50001 certified companies in Thailand in 2016, for 10 % of these certifications it could be verified that they were carried out within the IEE context.

Figure 11 Share of IEE-intervention companies with ISO 50001 certification in total ISO 50001 certifications in Thailand in 2016



Source: Own graph based on ISO (2017).

Observing the results on output level, it is safe to say that the project succeeded in adding significant human capacity to the industrial energy efficiency market of Thailand. While energy efficiency has been an important issue in Thailand prior to the project, UNIDO's integrated training approach providing on-site learning experiences is an innovative approach in the country. Following a proven best practice methodology and a structured, systematic approach, the project provided beneficiaries with technical skills, increased awareness at management level, and delivered proofs of concept.

The stakeholders interviewed drew a very positive balance of the project's results. Particularly the system optimization approach was described as an innovative spark. The interviewees stated that overall, energy efficiency was gaining more widespread attention in Thailand and also, industrial demand for energy efficiency services and the number of consultants offering those services was growing steadily.

2.2.2. Behavioural change

2.2.2.1. Economically competitive - Advancing economic competitiveness

Improved economic competitiveness of participating companies

As Table 12 in Annex VI shows, savings from direct interventions undertaken under component 4 *Implementation of energy management and systems optimization projects*, could be verified for 44 companies and 94 companies that had sent their staff to training reported savings for 276 measures that were implemented.

Improved economic competitiveness of training participants

The project successfully developed human resource capacities in Thailand. The project welcomed 5,140 participants (17 % females) to its activities. 87 individuals succeeded in passing the examination of national experts. Participants rated the courses overall as having a high quality. The evaluation team could only ask a limited number of national experts to what degree the course affected their hireability or income; statements were inconclusive. Trained staff stated that it might increase their hireability but none of the (non-representative number of) respondents had received wage increases.

2.2.2.2. Environmentally sound – Safeguarding the environment

The project contributes to changes in the environmental status by reducing the input of fossil fuels and reducing GHG emissions. It also mitigates negative impacts related to the extraction of fossil fuels and adverse effects of fossil fuel combustion, such as ambient air pollution and eutrophication. It should be noted that all monitored effects were gross savings and no analysis of net savings has been undertaken.

To further increase the positive environmental contribution even beyond the achievement of the project in question, a series of adjustments could be made.

Stronger alignment according to decarbonization and resource efficiency

Positive environmental effects could have been increased by embedding the project in a broader vision of resource efficiency and decarbonisation. Energy efficiency works as one component of both of the two sustainability dimensions and should be viewed to benefit those higher-level goals which outweigh energy efficiency as a goal in itself or can even be in contradiction to them.³⁷ Particularly from the view point of system optimization, aspects of heat recovery and integration of renewable energy should be viewed holistically. The considerations of embedded energy, resource consumption and decarbonisation should find their way into designing sustainable energy efficiency projects.

Use of standard factors for rebound effects

The IEE project has the following goal: *“The objective of the project is to promote industrial EE [...] to make its operations more reliable and competitive”*. Industries carry out energy efficiency to decrease production costs and increase profitability. Companies can achieve economic advantages over competitors and increase their market share or sales volume based on lower production costs. Having this objective as well as effects of energy efficiency in mind, the project should include factors to quantify the rebound effect and report net emission reductions rather than only gross effects. Simplified rebound factors that do not require scenario modelling – but for that reason are not fully accurate - can be the use of emission factors for re-invested energy

³⁷ Energy efficiency is not in all cases in line with decarbonization, to give an example, implementing decarbonization by switching to renewable energy can require industrial processes to follow the load of fluctuating electricity at the expense of running a system most energy efficient at constant load levels. Energy efficiency can also be carried out at the expense of resource efficiency, e.g. a modern high-energy efficient fridge should be utilized for a long period of time because the energy embedded in the material production process outweighs the energy savings potential of a fridge of an even later generation.

savings, such as *g CO₂/ USD of energy saved* (e.g. over a five year savings period) with the CO₂-emission factor depending on the average emission intensity of a countries' economy.³⁸

Engagement codex with industrial companies

The IEE Thailand project targeted the following sectors: 1) food products and beverages, 2) textiles, 3) chemicals, 4) rubber and plastic products, 5) non-metallic and mineral, 6) basic metal and 7) pulp and paper. Petroleum and natural gas extraction (the petroleum is the upstream resource provider for both chemical and plastic producers) and the palm oil sector are among the sectors listed among the top 100 business sectors responsible for environmental damages.³⁹ Embedded in a holistic vision of sustainability, more guidance might be needed on how to engage high-environmental-impact industries and their downstream users. A possible safeguard could be limiting engagement to companies that have an ISO 140001 certification or adhere to alternative certifications.

2.2.2.3. Socially inclusive – Creating shared prosperity

By design, the choice of participants was not directed at benefitting specific groups or entities in society such as ethnic or religious, minorities or women. Except for gender composition, no data on social stratification or social indicators were collected by the project.

2.2.3. Broader adoption

2.2.3.1. Mainstreaming

Prior to the project, Thailand already had advanced EE laws and policies in place including a national EnMs standard. A policy component was therefore not deemed necessary nor demanded at the design phase of the project. Nevertheless, the project might have benefited from a more active approach, especially after its' mid-term, to the policy and enabling environment to be able to engage in strategic discussions with the relevant ministries for the further advancement of the already robust energy efficiency policies in Thailand. One of the issues raised to the evaluation team by industrial companies was that different requirement of national EnMs standards and ISO 50001 de-incentivised certification as it was viewed as a double burden. While there were discussions regarding integrating ISO 50001 into the energy audit requirements of the designated companies (i.e. a company implementing ISO 50001 would be considered as duly complying with the law) around 2015, this never materialized. Mainstreaming ISO 50001 and ESO into national policy and regulations would have been a good opportunity for the project's training activities to stay relevant and sustainable.

2.2.3.2. Replication

The IEE project targeted seven industrial sub-sectors and was in direct contact with 1,048 industrial enterprises. Scaling up energy management and systems optimization in industry was to be addressed through increased capacity and awareness of the energy-using enterprises, the technical services and equipment supply chain as well as the development of a peer-to-peer

³⁸ To be more accurate economy-wide GHG-intensity would need to be based on a future development scenario for the period in question, which can be generated by extrapolating historic emission intensity developments into the immediate future.

³⁹ Trucost (2013).

network where industry can exchange experiences. The IEE project intended to work as a catalyser to improve the enabling environment for increased industrial EE by implemented demonstration activities, produce showcases and train human resources to promote future activities within industrial facilities. Another component of the project involved the development of harmonized criteria for evaluating energy efficiency projects by working with financial institutions to establish clear criteria for evaluating these projects for financial feasibility.

As laid out already in considerable detail in the Theory of Change (Figure 7), beyond its project outputs the project seeks broader adoption by non-intervention companies via awareness-raising and changes of framework conditions. Table 4 presents an even more detailed description of the project's replication pathways.

The project seeks replication for the following activities (column 1 of Table 4): (1) the UNIDO learning approach, (2) the system optimization approach to energy efficiency, (3) energy management systems and (4) specific technical applications (case studies).

Intended recipients of information on these activities/products are i) managerial staff of non-intervention companies ii) practitioners in the field of energy efficiency, iii) other information disseminators and iv) policymakers (last column of the table).

Information can travel along a series of pathways, some of which the project itself has established, others which are outside of the project's control (column 2 of Table 4). Replication occurs...

- a) via project website (established by the project),
- b) between different company departments,
- c) within company groups,
- d) via external consultants (national experts trained by the project),
- e) via reward scheme (established by the project),
- f) via the supply chain/vendors (trained by the project),
- g) via institutions lecturers/academia/training centres (the project worked with the TEM project and made a university BA course available).

Possible proxies for outreach of these information channels are number of website visitors / downloads of case studies from the website, surveys of intervention companies, surveys of external consultants, interviews, and surveys of trained vendors (column 3 in Table 4).

Table 4 Replication pathways and possible proxies to measure outreach of information channels

Information / activities / approach	Replication channel	Proxies to measure outreach	Target groups for replication and further outreach
(1) Learning approach (onsite training) (2) System optimization approach (3) Energy management systems (4) Specific technical applications (case studies)	a) via the project website	➔ # website visitors/ downloads	i. Management of non-intervention companies ii. Practitioners iii. Disseminators iv. Policymakers
	b) within company departments	➔ Survey of intervention companies	
	c) within company groups	➔ Survey of intervention companies	
	d) external consultants (national experts)	➔ Survey of external consultants	
	e) reward scheme	➔ Interviews: Has the reward scheme or the winning company received project requests?	
	f) via the supply chains / vendors	➔ Survey of vendors	
	g) via institutions: lecturers / academia / training centres	➔ Interviews, requests for the university course	

Source: own diagram.

The project surveyed pilot companies in respect to their energy savings, replication rates were omitted to be collected in this process. None of the other replication routes was surveyed. The website had been overlooked in the budgeting of the project and only added later to the project; a tracking of visitors was not included at that point. It is unclear to what extent the website was known or utilized by the target group. This is particularly crucial since it is the only source where the case studies are available for download.

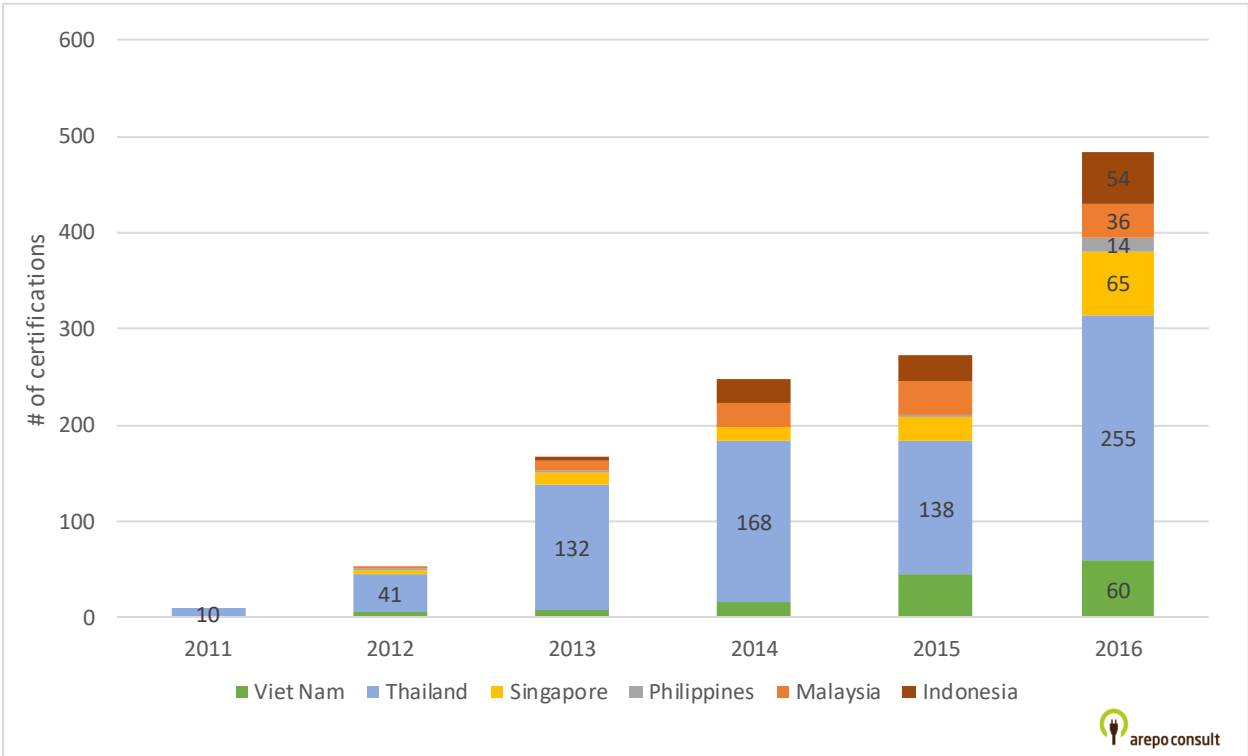
2.2.3.3. Scaling-up

There is no data available to the evaluation team to trace suitable indicators for a scale-up of the project's results on a larger geographical scale. Possible indicators would be "investment in energy efficiency in Thailand" or "industrial sites with an energy management system in place".

ISO 50001 certifications are another possible proxy for estimating scale-up, the indicator is published annually. Figure 12 shows, that between 2012 and 2016 ISO 50001 certifications in Thailand increased from 41 to 255. The increase has been much stronger than in other neighbouring countries. 25 of these additional certifications were carried out within the IEE project (compare Figure 11). The limitation of this indicator for measuring scale-up are the following: i) certifications do not allow the identification of the number of companies certified for the first time, ii) many companies do not recertify or do not recertify annually, iii) many companies in Thailand do not have an obvious benefit from a certificate and might introduce an uncertified energy management system.

Based on ISO 50001 certifications only, there are indications that interest in energy efficiency and energy management systems among the industry in Thailand is increasing.

Figure 12 ISO 50001 certifications in ASEAN and Viet Nam



Source: Own graph based on ISO (2017).

Summary of Progress toward Impact

Evaluation Criteria A) Impact (or progress toward impact)	
<ul style="list-style-type: none"> - <i>Mainstreaming</i>: To what extent information, lessons or specific results of the project are incorporated into broader stakeholder mandates and initiatives such as laws, policies, regulations and project? - <i>Replication</i>: To what extent the project’s specific results (e.g. methodology, technology, lessons and etc) are reproduced or adopted - <i>Scaling-up</i>: To what extent the project’s initiatives and results are implemented at a larger geographical scale? - What difference has the project made to the beneficiaries? - What is the change attributable to the project? To what extent? - What are the social, economic, environmental and other effects, either short-, medium- or long-term, on a micro- or macro-level? - What effects are intended or unintended, positive or negative? <p><u>The three UNIDO impact dimensions are:</u></p> <ul style="list-style-type: none"> - <i>Safeguarding environment</i>: To what extent the project contributes to changes in the status of the environment? - <i>Economic performance</i>: To what extent the project contributes to changes in the economic performance (finances, income, costs saving, expenditure and etc.) of individuals, groups, and entities? - <i>Social inclusiveness</i>: To what extent the project contributes to changes in capacity and capability of individuals, groups and entities in society, including vulnerable groups, and hence generating employment and access to education and training? 	
Summary of findings	
<ul style="list-style-type: none"> - Impact indicators only track gross savings and do not track market transformation - Large scale interaction with industry - Adding significant human capacity to the industrial energy efficiency market of Thailand - Achievement or overachievement of most of the project targets - Outputs were dynamically adapted to be most effectively carried out 	
Rating	
Impact (or progress toward impact)	Satisfactory

3. Project's quality and performance

This section of the report addresses the quality and performance of the project, looking at five relevant evaluation areas – project design, relevance, efficiency, sustainability and gender mainstreaming.

3.1. Design

3.1.1. Overall design

The project was designed in 2008-2010, GEF CEO endorsed in February 2011 and but started implementation in March 2011.⁴⁰ The design had a clear target on improving the human capacity to carry out energy efficiency work in Thailand. According to the interviewees, the project design worked well and satisfied a national demand for a better-qualified workforce. The design of the project management framework and institutional structures were clearly thought through and this facilitated smooth project implementation. The IEE pilot project contributed to strengthening the local technical and managerial capacities on energy efficiency and therefore assisted the Government in its overall energy efficiency strategy.

Continuation of the project design throughout the project implementation

The original project design was followed throughout the project implementation. Fewer funds were spent in component 1, and more funds spent in component 2 and component 3 than originally planned, with the overall donor budget lines left in place (Figure 15 of section 0).

Monitoring, evaluation and risk assessment at design phase

The project design included a Monitoring and Evaluation Plan which was budgeted with 3 % of the total project budget which can be considered as sufficient for what has been carried out.

The project document included a risk assessment and mitigation approaches.

⁴⁰ The project was endorsed by GEF on February 4, 2011. The Royal Thai Government approved the project cooperation according to the legal protocol on March 6th, 2012. Therefore, the PSC meeting held on March 27th, 2012 has designated the 6th of March as a project's starting date.

3.1.2. Results on design

Evaluation Criteria B) project design	
<ul style="list-style-type: none"> - The problem, need or gap to be addressed by the project is clearly identified, with clear target beneficiaries? - The project design was adequate to address the problems at hand? - Is the project consistent with the Country's priorities, in the work plan of the lead national counterpart? Does it meet the needs of the target group? Is it consistent with UNIDO's Inclusive and Sustainable Industrial Development? Does it adequately reflect lessons learnt from past projects? Is it in line with the donor's priorities and policies? - Is the applied project approach sound and appropriate? Is the design technically feasible and based on best practices? Does UNIDO have in-house technical expertise and experience for this type of intervention? - To what extent the project design (in terms of funding, institutional arrangement, implementation arrangements...) as foreseen in the project document still valid and relevant? - Does it include M&E plan and adequate budget for M&E activities? - Risk management: Are critical risks related to financial, social-political, institutional, environmental and implementation aspects identified with specific risk ratings? Are their mitigation measures identified? Where possible, are the mitigation measures included in project activities/outputs and monitored under the M&E plan? 	
Summary of findings	
<ul style="list-style-type: none"> - The design is clear and effective. The design was followed during project implementation. - The design included Monitoring and Evaluation as well as risk management. 	
Rating	
B) project design	Satisfactory (S)

3.1.3. Logframe

Expected results

The Evaluation team found that the project document is clearly drafted and easy to read and understand.

Unfortunately, however, the logical framework matrix does not include outcome indicators. While output level indicators were included, outcome indicators were ignored in the design and only outcome descriptions had been formulated. Table 13 presents the original outcome statements.

The lack of indicators means that intended outcomes following the outputs are neither specified nor measurable. To give an example, Output 1.3. "*National experts/factory personnel trained on ISO compliant energy management systems*" with a target of 500 factory managers, would have benefited from an outcome-level indicator tracing how many of the participants introduced an EnMS at their factory.

Similarly, for an output indicator such as “3.2 *Number of financial institutions and local banks personnel trained*”, it would have been useful to track the success of these training sessions and the subsequent rollout of credit lines or intended activities by banks.

Indicators

The results framework included objectively verifiable performance indicators, means of verification for the project objectives⁴¹ and 13 outputs.

Impact indicators

The impact indicators (project objective) are only measuring the gross energy savings achieved by participating companies but are insufficient to track the promotion of energy efficiency in the wider industry.

Outcome indicators

Outcome indicators are missing from the original logframe.

Output indicators

The logframe is equipped with 17 output indicators and 21 targets. A small number of indicators were assigned several targets which leads to the number of targets being higher than the number of indicators.

Most of the output indicators were sufficiently specific, measurable, achievable, relevant and time-bound (SMART) and follow the principles of Results Based Management. Only three of the 21 targets were not formulated adequately and lacked quantifiable targets:

- Output 1.2. National campaign provided information to industry to adopt ISO 50001. *Target: Promotional literature distributed to industries to promote the adoption of ISO 50001.*
- Output 3.2. Number of financial institutions and local banks personnel trained to understand main features of EE projects and better appraise EE projects proposals. *Target: Strengthened capacity of financial institutions and local banks on EE projects evaluation.*
- Output 3.3. Number of trained facility managers/personnel in industrial energy efficiency project development. *Target: Industrial facility managers/personnel have the capacity to analyse systems optimization and energy management projects and use energy and O&M costs reduction projects*

The output indicators used were either quantitative (How many?) or binary (yes / no). The project design would have benefited from indicators measuring the quality of the outputs, such as “satisfaction with training material provided”.

Gender was not considered at the project design phase. In reaction to the recommendations made in the MTR, indicators for participation in training activities were tracked sex-disaggregated, but no gender targets were formulated retroactively.

⁴¹ Electricity savings: 83,712 MWh, Fuel savings of 1,914,142 GJ, Emissions reduction of 196,757 t CO₂ during the project duration.

Sources of verification

The project document lists a series of data sources to measure the output indicators:

1. Project's own reporting: Annual report on web-based participating facility results, Terminal report, Awareness campaign report, project progress and annual reports
2. Award ceremony highlighting successful projects
3. Case studies from national experts
4. End-of- project survey
5. List of training sessions attendees
6. Peer-to-peer network
7. Reports of UNIDO's (international) experts
8. Training sessions report

Data sources chosen at project design stages can be considered suitable, as they are cost-effective, reliable and readily available to verify the status of the output indicators before project completion.

Only verification source 6 (peer-to-peer network) proved not suitable and was replaced by a monitoring survey during project implementation.

Assumptions in the logframe

Assumptions are those external factors over which the project has no influence, but which are relevant for the functioning of the logic chain. For changes to happen along the causal pathways towards outcomes and impact, a number of external conditions need to be met and several external factors need to be present. The assumptions (see also Table 5 of Annex VI) are confined to statements referring to the "continuous support", "willingness", "participation" and "commitment" of the stakeholder groups. The statements are very similar and generic. This is largely due to the fact that the more interesting assumptions regarding the outcome level are missing from the results chain. Assumptions from output to outcome level might have been:

- Energy prices are insufficient to make energy efficiency investments economically viable.
- Sufficient qualified external consultants are available in the market to assist companies in carrying out energy efficiency measures.

Evaluation Criteria for B2) Logframe

- *Expected results:* Is the expected result-chain (impact, outcomes, and outputs) clear and logical? Does impact describe a desired long-term change or benefit to a society or community (not as a means or process), do outcomes describe change in target group's behaviour/performance or system/institutional performance, do outputs describe deliverables that project will produce to achieve outcomes? Are the expected results realistic, measurable and not a reformulation or summary of lower-level results? Do outputs plus assumptions lead to outcomes, do outcomes plus assumptions lead to impact? Can all outputs be delivered by the project, are outcomes outside UNIDO's control but within its influence?
- *Indicators:* Do indicators describe and specify expected results (impact, outcomes, and outputs) in terms of quantity, quality and time? Do indicators change at each level of results and independent from indicators at higher and lower levels? Do indicators not restate expected results and not cause them? Are indicators necessary and sufficient and do they provide enough triangulation (cross-checking)? Are they indicators sex-disaggregated, if applicable? Are the indicator SMART?
- *Sources of verification:* Are the sources of verification/data able to verify status of indicators, are they cost-effective and reliable? Are the sources of verification/data able to verify status of output and outcome indicators before project completion?
- *Assumptions:* Are key assumptions properly summarized and reflecting the proper level in the results chain in the logframe?

Summary of findings

- *Expected results:* The design does not have verifiable indicators at outcome level within the project logframe.
- *Indicators:* Close to all output indicators satisfy the SMART criteria.
- *Sources of verification:* Almost all data sources chosen at project design stages were suitable.
- *Assumptions:* Though assumptions were completed for output level, since outcomes were missing from the logframe the most relevant assumptions were missing, too.

Rating

B2) Logframe

Moderately satisfactory

3.2. Relevance

Work on energy efficiency issues is fully aligned with the UNIDO mandate to “*promote industrial development and co-operation on global, regional and national as well as on sectoral levels*”.⁴² The project was consistent with UNIDO’s mandate and its comparative advantage within the UN family.⁴³ UNIDO has been successful in introducing and promoting energy management standards as the principal market-based policy tool to make energy efficiency part of best industry practice. UNIDO is internationally recognized as a leading advocate and provider of technical assistance on industrial energy efficiency policies, energy management standards and industrial energy systems optimization.

The project was funded as part of GEF-4th strategic program 2. Climate change Strategic Program 2: 2.2 “*To promote energy-efficient technologies and practices in industrial production and manufacturing processes*”.⁴⁴ (see textbox 2). The project was in line with many of the elements of the strategic program, particularly in respect to the increased deployment of EE technologies and saving practices addressing steam systems. Additional work on electricity generation, e.g. in CHP systems would have even increased the accuracy of fit.

Textbox 2 - Strategic Program 2: *Promoting Energy Efficiency in the Industrial Sector*

This program will promote energy efficiency in the industrial sector, including the deployment and diffusion of energy-efficient technologies and practices in industrial production and manufacturing processes. A successful outcome will be the increased deployment of energy-efficient technologies and adoption of energy-saving practices. Indicators of success will be tons of CO₂e avoided, volume of investment in new, more efficient plants and equipment, and the quantity of energy saved. This strategic program covers the energy systems in industrial manufacturing and processing, including combustion, steam, process heat, combined heat and power, electricity generation, and other public utilities. SME’s in developing countries demonstrate significant potential for improved efficiency and reduced GHG emissions as they frequently have limited access to the technology and capital necessary for improving their facilities. Adoption of an appropriate energy pricing framework is essential to ensure project effectiveness.

Project alignment with Thai priorities

The project directly supported the government’s energy efficiency programs and was in line with the government’s energy regulatory and policy framework. The project outcomes contribute to national priorities. The most relevant government agencies were involved in the preparation and implementation of the IEE project including the Ministry of Industry with its departments (DIP, DIW) and the Thai Industrial Standards Institute and the Ministry of Energy with its Departments DEDE, EPPO). The project complemented the work undertaken by the DEDE on energy management standards. It complemented the efforts of DIP and DEDE towards improving the energy efficiency of industries and thereby, making industrial operations more reliable and

⁴² UNIDO (1979) Article 1.

⁴³ “UNIDO should serve as a global facilitator of knowledge and advice on policies and strategies towards achieving inclusive and sustainable industrial development; and should focus on the three thematic priorities in which it has comparative advantage and expertise: productive capacity-building, trade capacity-building, and sustainable production and industrial resource efficiency” (UNIDO, 2013).

⁴⁴ GEF (2007).

competitive. The project's lead national counterpart was the Department of Industrial Promotion of the Ministry of Industry. DIP contributed part of its co-financing in the form of SO assessments carried out in the TEM project. Another important partner in the project was TISI which was consulting factories on ISO 50001. IEE supported TISI financially to continue ISO 50001 training. TISI is in charge of standards but with no special focus on energy. Many of the project activities in component 1 and 2 could have benefited from an additional cooperation with DEDE's BEHRD training facility, but cooperation over institutional boundaries proved difficult.

3.2.1. Results on relevance

In sum, the IEE project is relevant to national energy priorities, and has enjoyed strong participation of local stakeholders in project identification. The project is relevant to UNIDO and its aim to reduce energy consumption resulting in a corresponding reduction in GHG emissions. The project is fully consistent with the GEF climate change focal area.

Evaluation criteria for C1) Relevance	
<ul style="list-style-type: none"> - How does the project fulfil the urgent target group needs? - To what extent is the project aligned with the development priorities of the country (national poverty reduction strategy, sector development strategy)? - How does project reflect donor policies and priorities? - Is the project a technically adequate solution to the development problem? Does it eliminate the cause of the problem? - To what extent does the project correspond to UNIDO's comparative advantages? - Are the original project objectives (expected results) still valid and pertinent to the target groups? If not, have they been revised? Are the revised objectives still valid in today's context? 	
Summary of findings	
<ul style="list-style-type: none"> - The overall project design is in line with national energy priorities and has enjoyed the strong participation of local stakeholders in project identification. - The project is relevant to UNIDO. - The project is relevant to the GEF focal area of climate change. 	
Rating	
C1) Relevance	Satisfactory

3.3. Efficiency

This section gives an overview of the extent to which the project has produced results within the expected budget and time frame.

Overall the project carried out more activities within its budget than originally planned. After the analysis of feedback from course participants, the project has developed seven additional courses to offer EnMS and SO training participants a mid-level course offer between the introductory user

training and the very time-consuming ten-month expert course.⁴⁵ A further addition to the original outputs has been the development of a Bachelor course available to universities.

Although the initial duration of the project was five years (March 1st, 2011 to June 2017), the actual project implementation took place from March 6th, 2012 till September 2018. The project received an extension of 14 months, because the outputs could not be completed within the original time frame (Table 5). The implementation of EnMS and SO projects in partner enterprises took longer and the project needed additional time to compile impact indicators, prepare the final report, transfer the equipment and conduct the terminal evaluation.

Table 5 Original work plan of the project

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Original project timeline	Planned implementation start March 1 st 2011		Mid-term Evaluation January 6 th 2013			Project Closing Date August 31 st 2016	
Project implementation	Actual project implementation start March 6 th 2012				Mid-term review date: April 2016		Project close: December 2017 Terminal Evaluation: July 2018

Source: PMU (2012).

⁴⁵ The new courses consist of: 1) CB Training: Technical-oriented course for CBs and AB, 2) AB Training: Transition and other related issues, 3) EnMS intensive training: four-days training in two months' time for the shorten version of expert training and case-based exercises, 4) M&V (ISO 50006 and 50015): overview of measurement and verification of energy baseline, EnPI and savings, 5) EnMS E-learning: Self-learning platform for EnMS. 6) SSO technical training: two-days training focused on the technical analysis and case-based exercises with the equipment demonstration, 7) CaSO technical training: the pattern is the same as SSO technical training.

3.3.1. Results on efficiency

Evaluation Criteria C3) Efficiency	
<ul style="list-style-type: none"> - How economically are the project resources/inputs (concerning funding, expertise, time...) being used to produce results? - To what extent were expected results achieved within the original budget? If no, please explain why. - Are the results being achieved at an acceptable cost? Would alternative approaches accomplish the same results at less cost? - What measures have been taken during planning and implementation to ensure that resources are efficiently used? Were the project expenditures in line with budgets? - Could more have been achieved with the same input? - Could the same have been achieved with less input? - How timely was the project in producing outputs and outcomes? Comment on the delay or acceleration of the project's implementation period. - To what extent were the project's activities in line with the schedule of activities as defined by the project team and annual Work Plans? - Have the inputs from the donor, UNIDO and government/counterpart been provided as planned, and were they adequate to meet the requirements? 	
Summary of findings	
<ul style="list-style-type: none"> - The project overachieved on many of its targets and created a large amount of additional capacity-building activities. - The outputs could not be delivered within the original timeline, the project was extended by 11 months. 	
Rating	
C3) Efficiency	Satisfactory (S)

3.4. Sustainability

Sustainability is understood as the likelihood of continued benefits from the project implementation after the project ends. This section reviews the exit strategy and the four aspects of risks that may affect project sustainability include financial risks, socio-political risks, institutional framework, and governance risks and environmental risks. These risks are assessed in this section.

Exit strategy and legacy of the project

The key result of the project are the trained human resources it leaves behind as a legacy. National experts continue to share their knowledge in teaching and training other experts. The evaluation team received anecdotal evidence of national experts teaching at universities and continuing training factory personnel. The national experts working within factories (as employees) have a lower outreach, since they are limited to their worksite but carry out the actual energy saving works at the shop floor and spread their knowledge to colleagues at their factory site or to future employers.

The project failed to fully hand over its products (case studies, website, and training materials) directly to one of the government's partners because the national counterparts that the project

was most engaged with (DIP and TISI) discontinued most of their training activities in the field of energy management and ISO 50001. Government expenditure for the TEM and the TLC project⁴⁶ was discontinued in 2016. For the time being one of DIP's main future activities in the field of energy efficiency will be limited to the President's Award Scheme for Industrial Energy Efficiency in Large Industry and SMEs. Only DEDE is still running training activities. Training equipment (e.g. a flue gas analyzer) was handed over to the DEDE training centre, BEHRD. But as DEDE was not the primary counterpart for the training activities throughout the project, the project's products were not institutionalized in BEHRD's training approach.

TISI has received the budget for constructing a website for energy management systems. However, it is very restricted financially and cannot continue with training or awareness-raising to a significant degree. TISI informed the evaluation team, that the planned TISI website TISI planned will not include the IEE material and case studies.

Since the IEE project is followed by the project "*Greening Industry through Low Carbon Technology Applications for SMEs*", the IEE website content was transferred to the GI-SMEs project's website. The content includes the EnMS material, three promotional videos and the case studies for download. The project team will utilize its experiences and some of the materials produced in the follow-up project as well.

PMU worked on an exit strategy and secured that training materials would remain available in the form of a university course. IEE developed a university training course for Bachelor students which can be requested by universities from HQ. At the time of the evaluation, the university course was awaiting approval by the Thai ministry of education and the evaluation team could not assess to what degree it will be taken up by stakeholders. The project is disseminating the course material throughout its expert network of university lecturers who can use the course materials prepared in their seminars and trainings.

Financial Risks: Industrial partners conveyed the impression that sufficient capital is available to carry out energy efficiency measures if management priorities are directed this way.

Socio-political risks: Limited political risks are observable to what degree the government is willing to impose higher energy prices on the industry to promote energy savings and create the economic business case for increased investment.

Institutional framework and governance risks: The current institutional framework for designated factories is not providing incentives to go for ISO 50001 certification but to fulfil minimum legal requirements only.

Environmental Risks: From an environmental perspective, sustainability of project outcomes is likely (L) based on the assessment that there are moderate environmental risks. IEE measures that have been promoted on this project are removing a number of environmental risks such as emissions from fossil fuel combustion. In future projects, more careful attention could be paid to rebound effects, which are particularly important in the case of working with industrial consumers (see section 2.2.2.2).

⁴⁶ It still seems possible that TLC might experience a revival if demand for training increases with the revised ISO 50001 version announced for 2019.

3.4.1. Results on sustainability of benefits

Evaluation Criteria C4) Sustainability of benefits	
<ul style="list-style-type: none"> - Will the project results and benefits be sustained after the end of donor funding? - Does the project have an exit strategy? C6: To what extent have the outputs and results been institutionalized? - <i>Financial risks</i>: What is the likelihood of financial and economic resources not being available once the project ends? - <i>Socio-political risks</i>: Are there social or political risks that may jeopardize the sustainability of project outcomes? What is the risk that the level of stakeholder ownership (including ownership by governments and other key stakeholders) will be insufficient to allow for the project outcomes/benefits to be sustained? Do the various key stakeholders see that it is in their interest that project benefits continue to flow? Is there sufficient public/stakeholder awareness in support of the project's long-term objectives? - <i>Institutional framework and governance risks</i>: Do the legal framework, policies, and governance structures and processes within which the project operates pose risks that may jeopardize the sustainability of project benefits? Are requisite systems for accountability, transparency and required technical know-how in place? - <i>Environmental risks</i>: Are there environmental risks that may jeopardize the sustainability of project outcomes? Are there project outputs or higher-level results that are likely to have adverse environmental impacts, which in turn might affect the sustainability of project benefits? 	
Summary of findings	
<ul style="list-style-type: none"> - The project will leave a legacy with a large work force of training participants who will keep applying their knowledge at their workplace. - From an institutional point of view, the handover of the training approach and material could not be completed because key national partners discontinued their activities. - Future projects could factor rebound effects into their overall assessment of impacts. 	
Rating	
C4) Sustainability of benefits	Likely (L)

3.5. Gender mainstreaming

The project design did not consider gender mainstreaming neither did the monitoring framework include indicators to track gender, establish a baseline or a needs assessment. UNIDO's gender policy was issued in 2015 and has not been included as a part of project activities retrospectively. Tracking gender composition of beneficiaries was added in response to the comments in the Mid-Term Review.

3.5.1. Gender composition of the Steering Committee

For the gender composition of the Steering Committee the following methodology was applied. Basis for the assessment was the presence of females as representatives of members and the presidency in each individual meeting.⁴⁷ This calculation approach counts each individual one time for each meeting, regular participants do appear up to five times in the count. Based on the five SC meetings a summative total was formed.

Over the course of the project the Steering Committee meetings were attended by 48 representatives of whom 20 were female (42 %) (see Figure 21 in Annex VI for details of each meeting).

3.5.2. Gender composition of project staff

Gender composition of project and evaluation team

For the purpose of this evaluation the evaluation team used only data that was readily available and chose the indicator “**share of females in list of staff employed by the project (name count).**” This indicator suffers from several short-comings: Head counts do not account for changes in staff, do not account for part-time project involvement, e.g. at HQ, and short-term employment and do not account for payment differentials.

One indicator to reflect the dynamics in staff composition that could be used by UNIDO are “**full-time positions by female employees / total full-time positions in the project (in person months)**”. An alternative indicator to also properly reflect payment gaps could be “**Sum of salary + benefit payments to female staff / total salary and benefits payments to all project staff (in USD)**”. A decision on a standard indicator to track gender composition of project teams and its operationalisation would need to be carried at by UNIDO HQ.

The National Project Team employed over the course of the project six different staff members out of which three were female (50 %). The National Project Coordinator was female.

The supporting team at HQ consisted of a male Project Manager and three female support staff (66 %). The evaluation was conducted by two individuals for the mid-term and two for the final review. The share of females in these teams was 80 %.

Gender composition of international experts and national trainers

Further aspects of gender composition to assess are the gender composition of i) international experts and ii) national trainers hired for training purposes. As pointed out in respect to the project team, payments made to these individuals or full-time work equivalents would more adequately reflect the gender composition, but this data is commonly not available, therefore the list of people is used in this evaluation.

Among the international experts no female expert was hired by HQ. International female experts can function as role models for female participants and normalize the presence of females in the field for male colleagues. The project could not recruit female international experts for the training which is unfortunate because it would have been an opportunity to promote females in the IEE field in Thailand. Data on the gender desegregation of national trainers was not available.

⁴⁷ The presence of non-voting observes was not taken into account.

3.5.3. Gender composition of beneficiaries

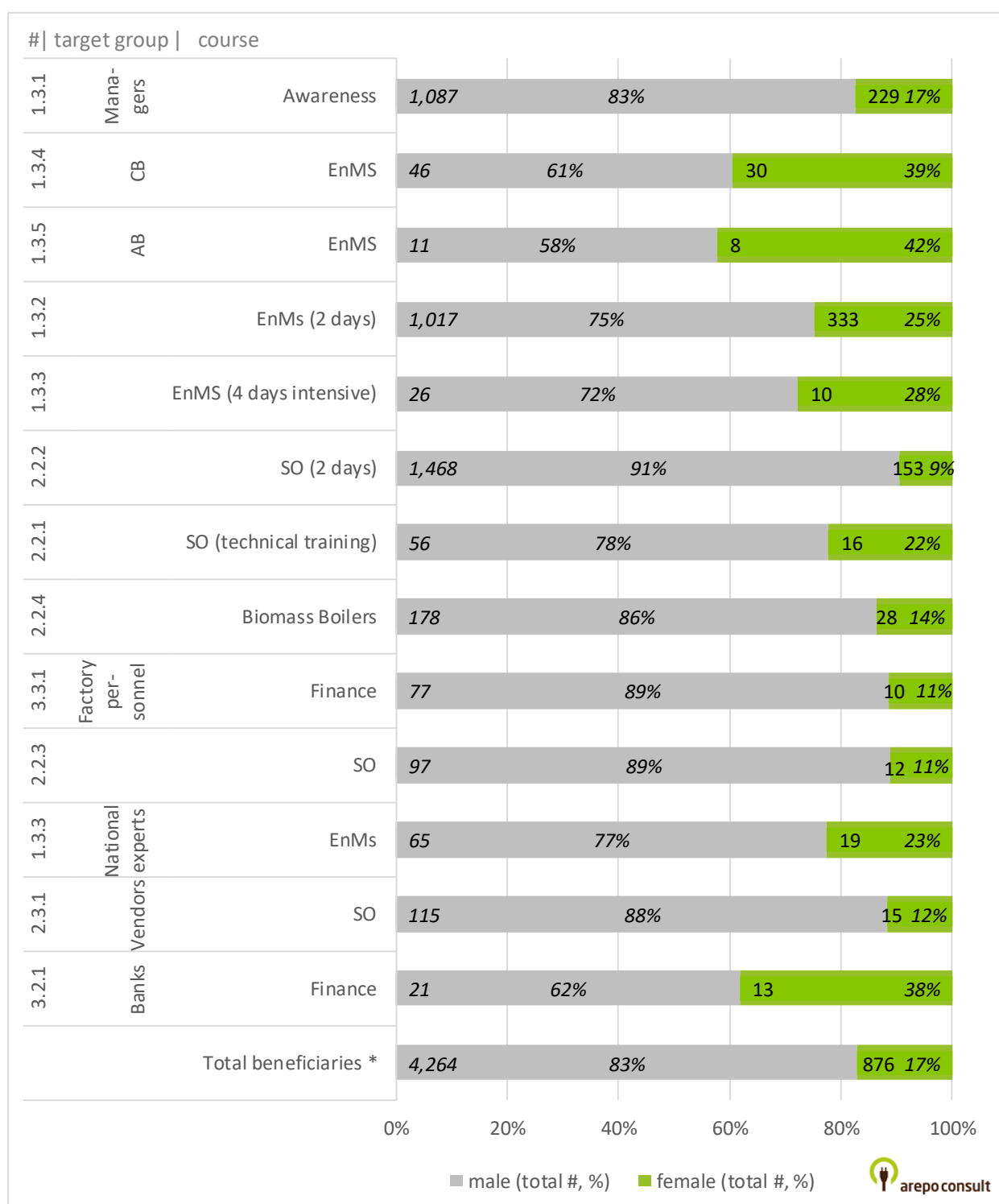
Beneficiaries were grouped according to their participation in training activities. Overall females only represented 17 % or 876 of the 5,140 participants (this includes a significant number of duplicates since many participants joined more than one activity). As can be seen in Figure 13 female participation was particularly low (below 20 %) in SO two-day training (2.2.1), finance training (3.3.1), SO expert training (2.2.3), SO vendors' training (2.3.1), biomass boiler training (2.2.3) and in the management awareness workshops (1.3.1).

Activities with a high share in participation from government bodies (AB and CB training (1.3.5, 1.3.4)) as well as training of bank staff (3.2.1) showed higher female participation rate than industrial sector dominated trainings.

Besides number of participants another important issue is, to evaluate the quality of the course and relevant gender specific experiences or barriers. The evaluation team could not collect a representative number of statements from female training participants about their gender specific experience in the training. Examples of such barriers can be if training participation collides with caretaker duties or a whether female participants felt they could participate in the training on an equal footing as male participants.

Higher shares of females in training activities in comparison to the baseline can potentially improve women's earning abilities and widen their career opportunities.

Figure 13 Gender composition of project beneficiaries



* The total number sums up training participants of different qualities of training and includes a significant number of duplicates, since participants frequently joined more than one activity.

Source: Own graph based on PMU (2018).

3.5.4. Results on gender mainstreaming

The project design did not include any mechanisms to encourage or facilitate the participation of females in the project's activities, no rating will therefore be applied to this criterion. The results from this analysis can serve as a baseline for comparisons of future projects.

Evaluation criteria for D1) Gender mainstreaming	
<ul style="list-style-type: none"> - Did the project design adequately consider the gender dimensions in its interventions? Was the gender marker assigned correctly at entry? - Was a gender analysis included in a baseline study or needs assessment (if any)? Were there gender related project indicators? - Are women/gender-focused groups, associations or gender units in partner organizations consulted/ included in the project? - How gender-balanced was the composition of the project management team, the Steering Committee, experts and consultants and the beneficiaries? - Do the results affect women and men differently? If so, why and how? How are the results likely to affect gender relations (e.g., division of labour, decision-making authority)? - To what extent were socioeconomic benefits delivered by the project at the national and local levels, including consideration of gender dimensions? 	
Summary of findings	
<ul style="list-style-type: none"> - Gender issues were not considered at the project design stage - A simple head count was used to assess gender composition. In the future, UNIDO might want to consider institutionalizing a better indicator for the gender ratio among UNIDO employees such as the indicator "<i>Full-time positions by female employees / total full-time positions in the project (in person months)</i>" or the indicator "<i>salary + benefit payments to female staff / total salary and benefits payments to all project staff (in USD)</i>" 	
Share of females in different groups (method of assessment)	
- SC meetings:	42 % (attendance count)
- National Project Team:	50 % (head count)
- Project team at HQ:	66 % (head count)
- Evaluation teams:	80 % (head count)
- International experts:	0 % (head count)
- Average beneficiaries:	17 % (attendance count)
Rating	
D1) Gender mainstreaming	Moderately satisfactory

4. Performance of partners

4.1. UNIDO

The Project Management Unit (PMU) was established in December 2011. There were four staff members under the PMU: The National Project Coordinator, two project assistants, the training officer and the driver. Initially, the project office was based in the UNIDO Regional Office in Bangkok in December 2012, and was later moved to a new project office in DIP's building.

The PMU team regularly reported to HQ in Vienna and sufficient support was given from the Project Manager with regular in-country visits for SC meetings and briefings. In between SC meetings, excellent communication and relationship between UNIDO and PMUs is assured by regular emails, phone calls and visits. The Project Manager also ensured exchange between the National Coordinators of other IEE projects in the region, e.g. with Viet Nam, so that National Coordinators learn about the (management) approaches of these teams. UNIDO HQ provided the PMU with sufficient support and quick responses. HQ provided sufficient guidance and leadership.

4.1.1. Results on performance of UNIDO

Evaluation criteria for E1) Performance of partners: UNIDO	
<ul style="list-style-type: none"> - Mobilization of adequate technical expertise for project design - Inclusiveness of project design (with national counterparts) - Previous evaluative evidence shaping project design - Planning for M&E and ensuring sufficient M&E budget - Timely recruitment of project staff - Project modifications following changes in context or after the Mid-Term Review - Follow-up to address implementation bottlenecks - Role of UNIDO country presence (if applicable) supporting the project - Engagement in policy dialogue to ensure up-scaling of innovations - Coordination function - Exit strategy, planned together with the government - Review overall effectiveness of project management as outlined in the project document. Have changes been made and are they effective? Are responsibilities and reporting lines clear? Is decision-making transparent and undertaken in a timely manner? Recommend areas for improvement. - To what extent the project has a proper and operational governance system (e.g. PSC with clear roles and responsibilities)? - Review whether the national management and overall coordination mechanisms have been efficient and effective? Did each partner have assigned roles and responsibilities from the beginning? Did each partner fulfil its role and responsibilities (e.g. providing strategic support, monitoring and reviewing performance, allocating funds, providing technical support, following up agreed/corrective actions)? - The UNIDO HQ-based management, coordination, monitoring, quality control and technical inputs have been efficient, timely and effective (e.g. problems identified timely and accurately; quality support provided timely and effectively; right staffing levels, continuity, skill mix and frequency of field visits)? 	
Summary of findings	
<ul style="list-style-type: none"> - Project staff was recruited in time. - UNIDO HQ provided the PMU with sufficient support and quick responses. - Exit strategy was developed 	
Rating	
E1) Performance of partners: UNIDO	Highly satisfactory

4.2. National counterparts

The Department of Industrial Promotion, Department of Industrial Works, Thai Industrial Standards Institute and Department of Alternative Energy Development and Efficiency were present in the SC meetings. The collaboration of the national counterparts and UNIDO was functioning well and the project team received support from the institutions. In the last stages of the project, the government's focus seems to have shifted towards digitalization and industry 4.0, with management systems receiving less attention. Besides digitalization of the industry, replacement of equipment and the award scheme are in the focus. As discussed above, the project developed an exit strategy independently of support from the national counterpart because DIP and TISI discontinued most of their training activities. A closer cooperation by DEDE and its training centre BEHRD might have been beneficial but could not be arranged.

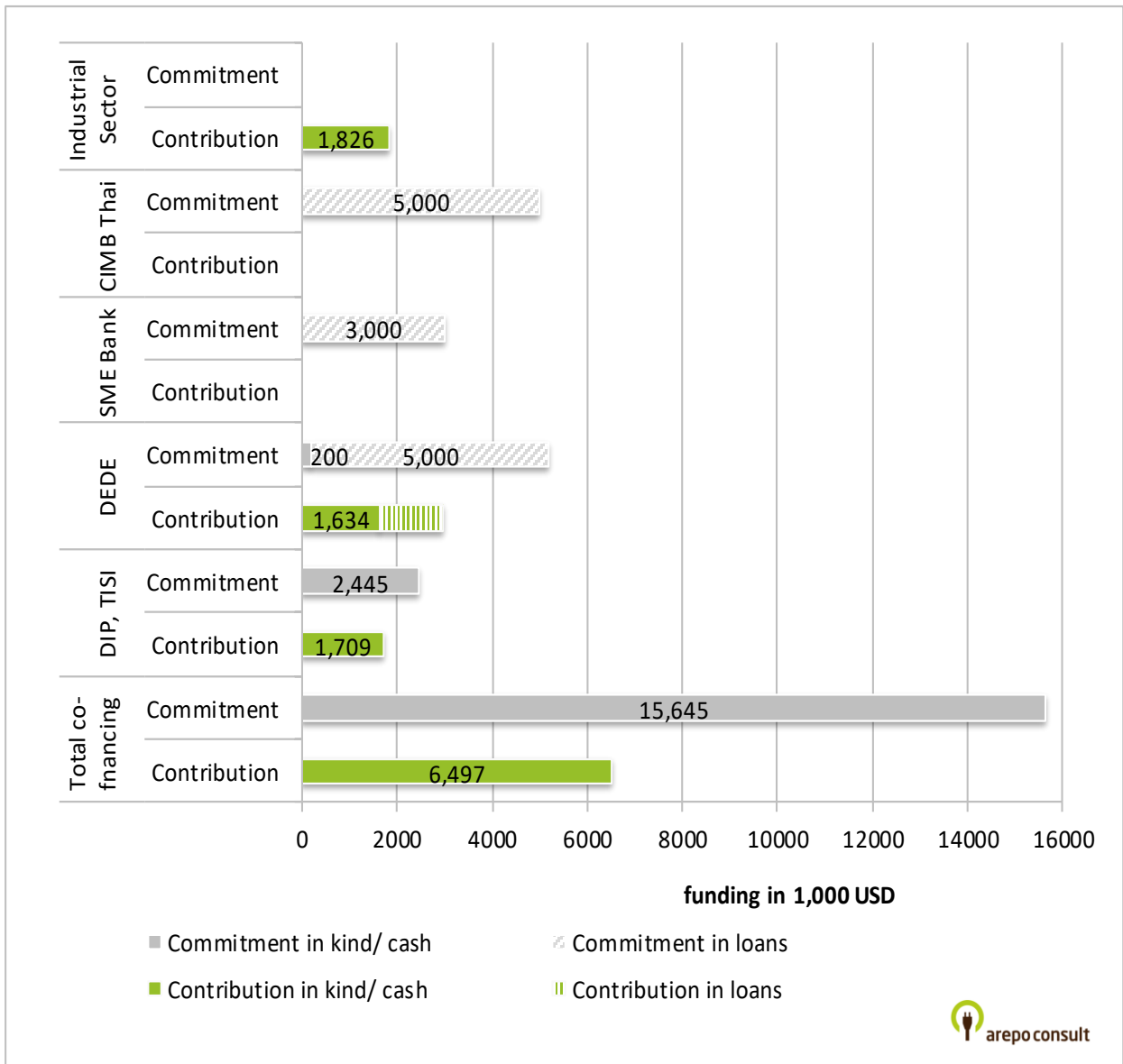
Co-financing

Originally, co-financing was planned to amount to USD 15,645,000 (Mol USD 2,445,000, DEDE USD 5,200,000, SME Bank USD 3,000,000, CIMB USD 5,000,000). Figure 14 shows the originally committed co-financing, indicating its type (loans, in kind or cash) versus the co-financing actualized. The actualized co-financing only reached 42 % and was therefore quite low. This was partially because the lending scheme of the participating banks (SME Development Bank and CIMB Thai) had not been used in the project. No loans were requested by participating factories of component 4 for energy management and system optimization. Most co-financing has been in the form of direct investments in energy management and systems optimization by the participating companies themselves.

The national counterpart's co-financing fell short of what had been pledged, 70 % of the pledged contribution of DIP / TISI were actualized. This was due to the fact that both TLC (TISI) and TEM (DIP) were stopped and no longer provided contributions to the project. DEDE reached 57 % of the pledge funding and converted a significant share of its contribution from loans to in-kind provision making it difficult to compare to the pledge.⁴⁸

⁴⁸ Pledges were USD 200,000 as in-kind and USD 5,000,000 as loans. Realized co-financing were USD 1,633,885 as in-kind and USD 1,328,605 as loans.

Figure 14 Co-financing versus original commitment (in 1,000 USD)



Source: own graph based on Final Report Annex B.

4.2.1. Results on performance of national counterparts

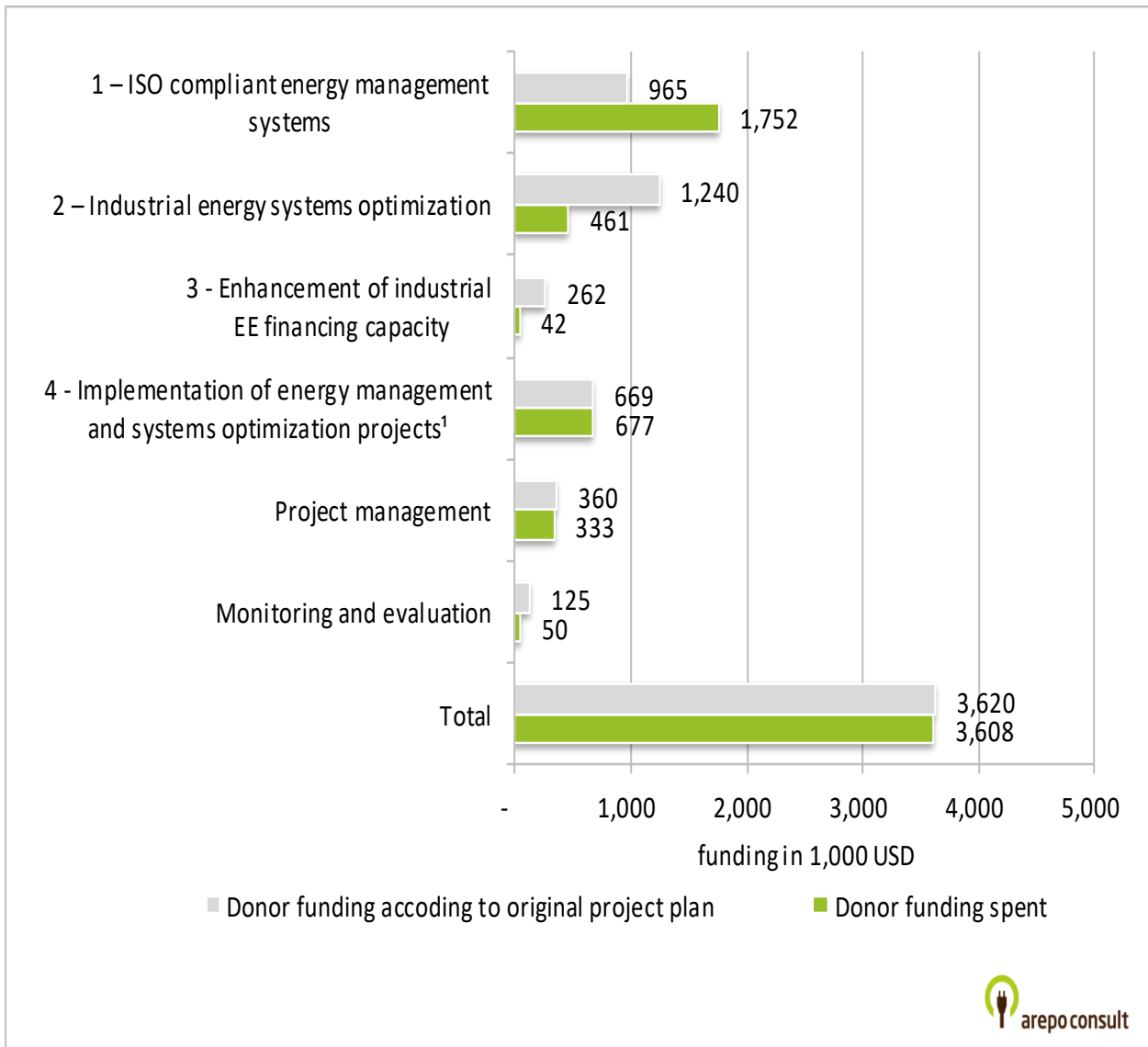
Evaluation criteria for E2) Performance of partners: National Counterpart	
<ul style="list-style-type: none"> - Design: Responsiveness to UNIDO's invitation for engagement in designing the project - Implementation: Ownership of the project - Implementation: Counterpart funding - Implementation: Provide financial contribution as planned (cash or in-kind) - Implementation: Support to the project, based on actions and policies - Implementation: Internal government coordination - Implementation: Facilitation of the participation of Non-Governmental Organizations (NGOs), civil society and the private sector where appropriate - Implementation: Suitable procurement procedures for timely project implementation - Implementation: Engagement with UNIDO in policy dialogue to promote the up-scaling or replication of innovations - Implementation: Exit strategy, planned together with UNIDO, or arrangements for continued funding of certain activities 	
Summary of findings	
<ul style="list-style-type: none"> - The collaboration of the national counterparts and UNIDO was functioning well - Co-financing has not been forthcoming as planned. - The exit-strategy was created outside of the national counterpart's institutions. 	
Rating	
E2) Performance of partners: National Counterpart	Satisfactory (S)

4.3. Donor

The GEF focal point was informed about project results existing status on a regular basis. The Thai GEF Focal Point participated actively in the project component 4 by handing over the award and certificates to the companies' management with the best case studies.

The disbursement rate of the GEF funds at time of the final evaluation was 99.7 %. Figure 15 shows the original budget versus actual spending of the GEF grant.

Figure 15 Original budget versus actual spending of GEF grant



Source: own graph.

4.3.1. Results on performance of donor

Evaluation criteria for E3) Performance of partners: Donor	
<ul style="list-style-type: none"> - Timely disbursement of project funds - Feedback to progress reports, including Mid-Term Review, if applicable - Support by the donor's country presence (if applicable) supporting the project for example through engagement in policy dialogue 	
Summary of findings	
<ul style="list-style-type: none"> - GEF disbursed funds in time and participated in project activities. 	
Rating	
E3) Performance of partners: Donor	Highly satisfactory

5. Factors facilitating or limiting the achievement of results

5.1 Monitoring and evaluation

Project monitoring and evaluation (M&E) was conducted in accordance with UNIDO and GEF rules and regulations. As discussed in the section on design above, however, no indicators were included in the logframe at the outcome level, therefore monitoring did not cover the project made on this level. The project document described M&E activities, responsible parties and allocated adequate funds.

Both UNIDO and National Project Team were responsible for implementing the M&E system. The institutional arrangement for carrying out M&E was as follows: UNIDO had the responsibility to oversee the project implementation through its internal monitoring. However, PMU was responsible for the day-to-day project management.

In its first annual plan PMU defined indicators and by which stage in the project the indicators were supposed to be met. PMU presented regularly an overview of inputs, work schedules and results to UNIDO and PSC in the form of Annual Reports. The main M&E outputs were progress reports, annual reports (2012, 2013, 2014, 2016), Mid-Term Review (2016) and the independent Terminal Evaluation (2018).

These well-laid out reports provide very accessible information on the project's achievements of targets, finances, and plans. In 2016 a Mid-Term Review supported the monitoring of progress and gave important suggestions for resolving certain issues particularly in respect to the formulation of an exit strategy. The Project Steering Committee has met five times in the course of the 6-year project.

5.1.1. Results of monitoring and evaluation

Evaluation criteria for D2) Monitoring & Evaluation	
<i>M&E design</i>	
<ul style="list-style-type: none"> - Was the M&E plan included in the project document? Was it practical and sufficient at the point of project approval? - Did it include baseline data and specify clear targets and appropriate indicators to track environmental, gender, and socio-economic results? - Did it include a proper M&E methodological approach; specify practical organization and logistics of the M&E activities including schedule and responsibilities for data collection; - Does the M&E plan specify what, who and how frequent monitoring, review, evaluations and data collection will take place? Is the M&E plan consistent with the logframe (especially indicators and sources of verification)? - Does it allocate adequate budget for M&E activities? 	
<i>M&E implementation</i>	
<ul style="list-style-type: none"> - How was the information from M&E system used during the project implementation? Was a M&E system in place and did it facilitate timely tracking of progress toward project results by collecting information on selected indicators continually throughout the project implementation period? Did project team and manager make decisions and corrective actions based on analysis from M&E system and based on results achieved? - Are annual/progress project reports complete, accurate and timely? - Was the information provided by the M&E system used to improve performance and adapt to changing needs? Was information on project performance and results achievement being presented to the Project Steering Committee to make decisions and corrective actions? Do the project team and managers and PSC regularly ask for performance and results information? - Are monitoring and self-evaluation carried out effectively, based on indicators for outputs, outcomes, and impact in the logframe? Do performance monitoring and reviews take place regularly? - Were resources for M&E sufficient? - How has the logframe been used for Monitoring and Evaluation purposes (developing M&E plan, setting M&E system, determining baseline and targets, annual implementation review by the Project Steering Committee...) to monitor progress towards expected outputs and outcomes? - How well have risks outlined the project document and in the logframe been monitored and managed? How often have risks been reviewed and updated? Has a risk management mechanism been put in place? 	
Summary of findings	
<ul style="list-style-type: none"> - M&E was considered during the project design phase. The M&E design followed UNIDO's standard M&E procedures and GEF guidance on project monitoring. - The M&E implementation has been very systematic, following the M&E plan rigorously, thus making it easier to track the timely progress by the project. - PMU prepared excellent reports which made progress easy to track 	
Rating	
D2) Cross-cutting performance criteria: Monitoring & Evaluation - Design and implementation	Satisfactory (S)

5.2 Results-based management

The project prepared well-laid out annual progress reports tracking the progress for each output indicator. The Reports, particularly the final report, followed the project's results framework in a clear fashion. The reports contain many charts and diagrams making the data easily accessible. PMU reported adaptive management changes to PSC in the annual progress reports, e.g. stating that *“after the analysis of feedback and the structure of the capacity building program, the project has developed 5 new courses to cover all relevant stakeholders and reach more audiences.”*

The project team documented its experiences and lessons learned in the final report. Among others, the project team struggled tracking the participating factories' activities, because the personnel attending the UNIDO training resigned or changed position and because investments have a significant time lapse for implementation.

5.2.1. Results on results-based management

Evaluation Criteria for D3) Results-based Management	
<p><i>Results-Based work planning</i></p> <ul style="list-style-type: none"> - Review any delays in project start-up and implementation, identify the causes and examine if they have been resolved. - Are there any annual work plans? Are work-planning processes results-based? Has the logframe been used to determine the annual work plan (including key activities and milestone)? - Examine the use of the project's results framework/ logframe as a management tool and review any changes made to it since project start. <p><i>Results-based monitoring and evaluation</i></p> <ul style="list-style-type: none"> - Verify whether an M&E system is in place and facilitated timely tracking of progress toward project objectives by collecting information on selected indicators continually throughout the project implementation period; - Review the monitoring tool currently being used: Do they provide the necessary information? Do they involve key partners? Are they aligned or mainstreamed with national systems? Do they use existing information? Are they efficient? Are they cost-effective? Are additional tools required? How could they be made more participatory and inclusive? - Do project team and manager make decisions and corrective actions based on analysis from M&E system and based on results achieved? Is information on project performance and results achievement being presented to the Project Steering Committee to make decisions and corrective actions? Do the project team and managers and PSC regularly ask for performance and results information? <p><i>Results-based reporting</i></p> <ul style="list-style-type: none"> - Assess how adaptive management changes have been reported by the project management and shared with the PSC. - Assess how well the project team and partners undertake and fulfil donor and UNIDO reporting requirements (i.e. how have they addressed delays or poor performance, if applicable?) - Assess how results and lessons derived from the adaptive management process have been documented, shared with key partners and internalized by partners. 	
Summary of findings	
<ul style="list-style-type: none"> - IEE Thailand followed a Results Based Management Framework containing an output indicators with a baseline, targets, and associated risk analysis. 	
Rating	
D3) Results-based Management	Satisfactory (S)

5.3 Overarching assessment and rating table

The IEE project was a successful and well-designed project complementing the existing impressive efforts by the Kingdom of Thailand in the field of energy efficiency. The project demonstrated a strong ability to learn and adapt its training offers according to local needs. The sustainability of the projects results was negatively affected by the discontinuity of training activities by key counterparts which

resulted in a lower institutionalization of training efforts than might have been hoped for. Nevertheless, the project leaves a strong legacy and played a lead role in driving ISO 50001 in Thailand. It contributed to an environment, particularly through capacity development, that enabled the consolidation of an energy efficiency market in Thailand.

5.3.1. Results on overall assessment

Evaluation Criteria F) Overall assessment	
<ul style="list-style-type: none"> - Overarching assessment of the project, drawing upon the analysis made under project performance and Progress to Impact criteria above but not an average of ratings 	
Summary of findings	
<ul style="list-style-type: none"> - Impressive contributions in human capacity added to the Thai energy efficiency market - Degree of institutionalization of training approaches slightly below expectation - Development of additional outputs and overachievements of targets - Development of an exit strategy by offering a university course 	
Rating	
F) Overall assessment	Satisfactory (S)

Table 6 project rating

	Evaluation criteria	Justification of ratings	Rating in the Terminal Evaluation	Rating in the Midterm Review
A	Impact (or progress toward impact)	The project has successfully promoted industrial energy efficiency and industrial productivity in Thailand and created a solid foundation for longer term impacts. The IEE project Thailand has been an effective enabler of energy efficiency implementation and has directly and indirectly contributed to energy, financial and greenhouse gas savings. The project introduced several methodological approaches how to manage energy to Thailand. The project has focused on capacity building for the implementation of EnMS and systems optimization. The project played a significant role in mainstreaming ISO 50001 among industry in Thailand and the 25 IEE-intervention companies concluding a certification amount to 10 % of all ISO 50001 certification in Thailand in 2016. It has provided opportunities for hands-on practical experience of the trainees and implementation of projects in participating pilot factories. The achievements in the financial component were slightly weaker than the outstanding achievements in the capacity building and implementation components: On impact level the project overachieved on its electricity-saving target by 133 %, its fuel-saving target by 142 % and its GHG emission reduction target by 126 %. Achieving a gross emission reduction of 197 Kt CO ₂ .	Satisfactory	
B	Project design	The project design is rated in respect to overall design and the logframe.	Moderately satisfactory	HS (Highly satisfactory)
1	Overall design	The overall design was satisfactory and was followed throughout the project implementation. The design was still valid by the end of the project. The project might have benefited from a policy and enabling environment component, which could have focused on embedding ISO 50001 and certain methodological approaches in legislation and curricular of public training facilities. The co-financing to be contributed in form of loans for EE implementation were not fully in line with the low-cost investments and managerial concepts targeted by the project.	Satisfactory	/

	Evaluation criteria	Justification of ratings	Rating in the Terminal Evaluation	Rating in the Midterm Review
2	Logframe	The logframe design is moderately satisfactory. Most, though not all, output level indicators were SMART and meaningful, but no outcome indicators were determined making it difficult to track the long-term effect the project might have had. Almost all data sources chosen at project design stages were suitable for monitoring. Though assumptions were discussed in the project document, since outcomes were lacking from the logframe the most relevant assumptions were missing.	Moderately satisfactory	/
C	Project performance		Satisfactory	
1	Relevance	The overall project design is relevant to the national energy priorities. The project is relevant to UNIDO and fully relevant to the GEF focal area of climate change.	Satisfactory	HL (Highly relevant)
2	Effectiveness	The project has been under implementation for almost seven years and its achievements compared to the targets show highly satisfactory results. In many cases, the project exceeded its end-of-project targets and reacting to the demand by adding capacity building components in additional to the project design. The review has concluded that all efforts were undertaken to ensure cost-effectiveness of the project results both by UNIDO as IA, PMU and the national project counterparts. In terms of the effectiveness of the project approach it should be noted that the institutional design did not lend itself to fully leverage the cooperation potential with similar training efforts carried out by DEDE's Bureau of Energy Human Resource Development. And that in terms of impact achievement it should be noted that many of the participating energy-using enterprises are companies that already have to adhere to energy management obligations set out in the Energy Conservation Promotion Act for designated companies.	Satisfactory	S (Satisfactory)

	Evaluation criteria	Justification of ratings	Rating in the Terminal Evaluation	Rating in the Midterm Review
3	Efficiency	Efficiency is rated in respect to the extent to which the project has produced results within the expected budget and time frame. The project was an efficient use of resources and produced far more outputs in terms of training courses offered than set out in the project design. Although counterpart resources and adequate project management arrangements were in place at project entry, the project has experienced some delays, particularly to monitor the project's impact. The project was extended by 14 months until September 2018.	Satisfactory	(S) Satisfactory
4	Sustainability	<p>The overall sustainability rating for this project is likely. There were no direct risks identified that affect the dimension of project sustainability, particularly not in respect to financial, socio-political, institutional framework and governance risks. In the field of environmental (ecological) risks the nature of the project type in the field of industrial energy efficiency demands a more analytical approach to indirect and direct rebound effects which can lead to significant difference between gross and net effects or even leading to an overshoot situation.</p> <p>In terms of longevity of results, there is no risk that EnMS and ESO will become redundant because Thailand has established a robust policy framework obliging industry to pay considerable attention to energy efficiency. Nevertheless, the project did not achieve a full-scale institutionalization and take-up of its approaches and materials by the counterpart institutions. The project did therefore make an effort to start a closer cooperation with university institutions which can be considered as innovative and pro-active approach to increase the long-term sustainability of the project's effects.</p>	Likely	L (Likely)
D	Cross-cutting performance criteria		Satisfactory	
1	Gender mainstreaming	Gender was not considered during project design or included after UNIDO passed its gender policy in 2015. The MTR encouraged sex-disaggregated indicator collection, which showed that 17 % of beneficiaries were females. No negative gender impacts were identified. Since no female international experts could be recruited by the project, the opportunity to present female role models in the sector could not be taken advantage of.	Moderately satisfactory	

	Evaluation criteria	Justification of ratings	Rating in the Terminal Evaluation	Rating in the Midterm Review
2	M&E: <ul style="list-style-type: none"> • M&E design • M&E implementation 	The M&E process and specific reporting requirements were sufficient to track the output targets and collect information about gross impacts (fuel savings, energy savings, GHG emission reductions) realized. The budget provided for M&E at the planning stage was sufficient. The project collected an impressive set of additional data, e.g. on activities of consultants and course feedback, but since the monitoring of such activities had not been listed in the reporting obligations, the data was not available in a concise form.	Satisfactory	HS (Highly satisfactory)
3	Results-based Management (RBM)	IEE Thailand followed a Results Based Management Framework containing output indicators with a baseline, targets, and associated risk analysis.	Satisfactory	
E	Performance of partners		Satisfactory	
1	UNIDO	Project management has been highly successfully carried out by the UNIDO Project Manager and project Management Team (PMT) led by the National Project Coordinator (NPC). PMU drafted the progress reports that provide the necessary aspects of the periodical achievements of the project, clearly linked the achievements with the output indicators of the logical framework. The reports are well laid out and highlight key achievements with icons. The report layout can serve as a model for other IEE projects. The Project Manager organized meetings of different National Coordinators in the region to learn and leverage experience outside of the country.	Highly satisfactory	
2	National counterparts	There has been good cooperation between the various project partners (DIP, TISI, DEDE and DIW) that closely work together with the PMU, met almost annually in the Project Steering Committee (PSC) and have set up a Working Group. A closer cooperation with the remaining training activities provided by the Thai government would have been beneficial to the institutionalization of project results.	Satisfactory	
3	Donor	GEF disbursed funds in time and participated actively in project activities.	Highly satisfactory	

	Evaluation criteria	Justification of ratings	Rating in the Terminal Evaluation	Rating in the Midterm Review
F	Overall assessment	The IEE project was a successful and well-designed project complementing the existing impressive efforts by the Kingdom of Thailand in the field of energy efficiency. The project demonstrated a strong ability to learn and adapt its training offers according to local needs. The sustainability of the projects results was negatively affected by the discontinuity of training activities by key counterparts which resulted in a lower institutionalization of training efforts than might have been hoped for. Nevertheless, the project leaves a strong legacy and played a lead role in driving ISO 50001 in Thailand. It contributed to an environment, particularly through capacity development, that enabled the consolidation of an energy efficiency market in Thailand. The successful development of the GEF-funded project “Greening Industry through Low Carbon Technology Applications for SMEs” demonstrates the success of IEE Thailand.	Satisfactory	

6. Conclusions, recommendations, and lessons learned

6.1. Conclusions

The project *Industrial Energy Efficiency in Thailand* was developed to promote EE improvements in Thailand's manufacturing sector through the implementation of the national energy management standard (EnMS) based on the internationally recognized ISO 50001 standard and application of system optimization (SO).

In alignment with the Theory of Change developed by the evaluation team for the overall evaluation of UNIDO's Industrial Energy Efficiency Programme Portfolio, the project addressed several target groups important for a transformation of the energy efficiency market. With the primary target group, the energy-using enterprises, UNIDO maintained relationships of different degrees of depth: *UNIDO partner companies* received extensive training and functioned as pilot sites, *light-intervention companies* were contacted with awareness-raising activities and were offered light training, companies in the *wider economy* were addressed via the website on which the case studies were presented, and by the media work of the award scheme that featured the pilot companies.

The project addressed the market conditions for the energy-using enterprises by addressing secondary stakeholders particularly the technical services and equipment supply chain with capacity building work for independent consultants and equipment vendors. In contrast to other IEE projects, the Thailand project included academics in their target group and developed a university course to feed UNIDO's approach into the education of engineers as part of its exit strategy. Financing also constituted a further framework condition to the energy efficiency market. It was addressed by the project to a very limited degree: a capacity-building exercise and the development of guidelines was intended to encourage financial institutions to increase their lending activities. Financing through loan schemes by participating banks which were included in the project design turned out to be not relevant.

Policy commitments and legal obligations on industrial energy efficiency in Thailand are comparatively mature. In contrast to other similar projects, IEE Thailand did not address the policy framework neither in the form of incorporating ISO 50001 in the legal framework nor to address adverse market conditions like fossil fuel / energy pricing structures.

The evaluation concludes that the project was **relevant** to national development priorities and received sufficient support of the key national stakeholders during its formulation. The project's focus on EE is well within the mandate of UNIDO which is widely recognized as a pioneer in promoting energy management standards as a key corporate management tool. The project is also consistent with the strategic objective 2 of GEF-4: tackling climate change through the promotion of energy-efficient technologies and practices in industrial production and manufacturing processes.

The evaluation of the project's **effectiveness** is based on the outputs and outcomes achieved by the project in its pursuit of promoting industrial EE through EnMS and SO. The project's achievements compared to the targets show highly satisfactory results. In many cases, the project

exceeded its end-of-project targets. Some shortfalls were noted in the finance component which seems to have been less effective than the capacity-building activities for energy-using enterprises. Banking institutions were trained on financial evaluation EE projects but no credit lines for EE have been developed by commercial banks resulting from the trainings. The review has concluded that all efforts were undertaken to ensure cost-effectiveness of the project results both by UNIDO as IA, PMU, and the national project counterparts.

The project was successful in creating an enabling environment for the adoption of energy management and system optimization practices in industrial establishments by raising awareness among industrial enterprises of the benefits of adopting EE, and in mobilizing experienced international experts for developing a cadre of trained EE professionals who can provide services on EnMS and SO. On output level, the project realized user training sessions on EnMS, benefitting 612 factory managers from 364 factories. 1,126 factory personnel from 344 factories attended user training sessions on system optimization. Additionally, 60 equipment suppliers / vendors of energy-efficient products were trained on SO. Thanks to the targeted hands-on expert training sessions organized by the project, 62 engineers from industrial facilities and national experts are equipped with knowledge and skill to assist industrial enterprises in adopting EnMS, and another 48 are certified as SO experts with the ability to assist industries in compressed air, pump, fan and steam systems optimization. In the finance component, 87 factory staff were sent for training on project financing and 34 staff from banks.

With the extended support by international and local experts, 50 medium and large industries implemented an EnMS out of which 25 went for certification – overall in Thailand there are more than 250 certified companies. 76 system optimization assessments were carried out leading to 74 implementation projects. 200 factories adopted an energy management plan. For the purpose of awareness-raising and proof of concept the project published 12 case studies on EnMS and 13 on SO. As reported in the final report of the project, the annual savings accrued from the action taken by the partner enterprises amount to 11,307 MWh of electricity (133 % target achievement) and 2,713,001 GJ in fuel savings (142 % target achievement). Emission reduction aggregates to 247,047 tons of CO₂ during the project duration (126 % target achievement).

The adoption of EnMS and SO approaches by industries combined with investments to lower the industrial energy intensity is bound to result in reduced energy needs and avoidance of GHG emissions. Nevertheless, the monitoring focuses on gross savings. Additional efforts need to be undertaken to monitor the net emission effects.

The key factors contributing to the success of the project are the strong collaboration of UNIDO and PMU with the key national public partners and private enterprises and a dynamic and proactive PMU that is well guided and supported by the UNIDO HQ staff.

6.2. Recommendations

The following recommendations derived from this Terminal Evaluation. Future projects would benefit from:

- **To GoT and UNIDO: *More careful attention to institutionalization and coordinated efforts***: The project might have benefited from a policy and enabling environment component, which could have focused on embedding ISO 50001 and certain methodological approaches in legislation and curricular of public training facilities.
- **To GoT: *Closer cooperation of government stakeholders***. DIP and TISI discontinued their training activities by the latter half of the project, therefore a closer cooperation with DEDEs training facilities in the training component might have been beneficial to formulate an exit strategy via this institution. This would have required a deviation from DEDE's role to be the main counterpart for the finance component only.
- **To UNIDO: Monitoring of project impact could be improved in respect to the following aspects:**
 - ***Improve the assessment of attribution***. PMUs should be equipped with practical tools for better estimating net impacts rather than only gross impacts as carried out currently. Examples of such monitoring tools are comparisons with a control group (e.g. How much did energy efficiency improve in industry overall?). Further attention has to be made to assess free-rider ship among partner enterprises to isolate UNIDO's contribution from the baseline of industrial enterprises improving energy efficiency anyhow. Such data can be collected e.g. via anonymous self-reporting (Would you have carried out the energy efficiency activity without the project?). Future projects might want to correct the project achievements by a factoring in (historic) autonomous energy efficiency development and by attempting to quantify the free-rider effect. These additional assessments help strengthen the meaningfulness and strength of the data collected.
 - ***Introduce a standard approach for consideration of rebound effects or standardized tools to assess rebound effects***. The difference between gross and net effects on impact level are also a result of rebound effects such as price decreases due to lower production costs and growth effects. These effects should be taken into consideration to make results more credible.
 - ***More attention to SMART outcome indicators***. Constructing **outcome-level** indicators – which are Specific, Measurable, Achievable, Realistic and Time-bound (SMART) and consistent with an explicit Theory of Change – and monitoring them during the implementation timeframe would raise projects' attention to the sustainability of benefits. Monitoring the outcome-level indicators could also support adaptive management, with possible remedial actions in areas where outcome-level achievements fall below expectations. In particular future projects should identify replication channels and monitor the strength of their outreach.
 - ***Use coherent survey tools***. IEE projects should be supplied with standardized (possibly online based) questionnaire formats to monitor the training participants shortly after the training regarding their satisfaction. A second survey should be used to track achievements on outcome level, e.g. replication data, activity rate and applicability of the training. Survey data from participants should at best be comparable over projects of a

similar nature in UNIDO's portfolio. A possible question could be e.g.: *"To what extent has passing the exam to become a UNIDO national expert..."*

- improved your position to negotiate wage increases or benefit packages with your employer?*
- increased your chances in the job market?*
- increased your ability to start your own company/work independently?"*
- **To UNIDO: *Become an inspiring example of gender equality.*** UNIDO should increase its efforts to deploy female international experts into partner countries.
- **To UNIDO: *Projects should be embedded in a broader vision of resource efficiency and decarbonisation.*** Energy efficiency should be viewed to benefit those higher-level goals which outweigh energy efficiency as a goal in itself or can even be in contradiction to them. The considerations of embedded energy, resource consumption and decarbonisation should also find their way into designing sustainable energy efficiency projects.
- **To UNIDO: *Secure parts of the awareness budget for finalized project website.*** In a comparatively mature market for energy efficiency, it might be useful to move some of the national awareness campaign budget to the end of a project to draw attention to a central media outlet such as the IEE website which is filled with local IEE content and particularly with case studies only late in the project lifetime.
- **To UNIDO: *Future projects might want to pay more careful attention to the needs of the independent national experts to work as energy advisers.*** For some of the experts beyond energy efficiency expertise further business skills might be beneficial to work as freelance energy advisers.
- **To GEF and UNIDO: *GEF should clarify concerns with specific sectors.*** Several of the sectors targeted by the IEE portfolio are high-environmental impact sectors contributing to significant amounts of pollution and natural habitat destruction, among them chemical industries, mining, palm oil plantations, and petroleum refineries. Some of such high-impact sectors were also targeted in the case of the project at hand to reduce their energy consumption. While no environmental damages are caused by the project itself, the project potentially facilitates the financial viability of the industrial activities and products. GEF should define clearly whether to work with certain type of industries under preconditions, e.g. obliging partner companies to adhere to sectoral sustainability certifications.

6.3. Lessons Learned

The pilot companies do not only have to fulfil formal requirements such as technologies in use but are more effective if they are also willing to engage with other companies and share their experiences publicly and among company networks.

6.4. Good practices

- The project prepared excellent reports which presented the findings in a well laid out fashion. Such a format could serve as an example for other projects.
- The team carried out an online course to maximize knowledge sharing in remote destinations.
- PMU addressed the academic community as an additional element for setting framework conditions. Closer cooperation with educational institutions might be a useful addition to similar projects.

Annex I. Evaluation Terms of Reference



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

TERMS OF REFERENCE

Independent Terminal Evaluation of UNIDO project:
Industrial Energy Efficiency in Thailand

UNIDO Project ID:
GEF ID: 3786
January 2017

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I. Project background and context⁴⁹

1. Project factsheet

Project title	Industrial Energy Efficiency in Thailand
PROJECT ID	103071
GEF ID	3786
Region	EAP
Country	Thailand
Project donor(s)	GEF
Project approval date	21-12-2010
Project implementation start date	03/01/2011
Expected duration at project approval	65 months
Expected implementation end date	31/06/2018
Executing partners	Department of Industrial Promotion (DIP); Department of Industrial Works (DIW); Thai Industrial Standards Institute (TISI); and Department of Alternative Energy Development and Efficiency (DEDE)
Donor funding	USD 3,620,000
Co-financing:	USD 15,645,000
Total project cost (USD)	USD 19,265,000
Mid-term review date:	April 2016
Planned Terminal Evaluation date	April 2018

(Source: project document)

2. Project context

This independent Terminal Evaluation assesses the performance of the GEF-funded project *Industrial Energy Efficiency in Thailand*. Approved in December 2010, the project's implementation phase started in January 2011, to be originally completed in December 2017. After an extension, though, the project is now expected to be completed by June 2018.

3. Rationale and origin of the projects

Since the beginning of 1990s, Thailand has always been at the forefront in terms of promoting industrial energy efficiency and energy savings. Over time, the Thai industry has made significant investments in energy efficiency supported by several major initiatives supported through energy conservation fund, energy efficiency revolving fund, utility-based DSM, total energy management

⁴⁹ Data in this chapter is to be validated by the Consultant against the project document and any changes should be reflected in the evaluation report.

program and active ESCO industry. Despite encouraging efforts in terms of regulatory policy framework, establishment of energy conservation funds, tax benefits and other incentives from the government, limited achievements have been observed in the field. In particular, energy management is still ad-hoc practice in the Thai industry as it is not integrated with the management system. Though most industries seem to consider energy management important mainly for production cost reduction, the number of enterprises which have actually implemented energy management good practices within their facility is really low.

To address such issues and barriers, multilateral technical assistance was sought from UNIDO and the GEF with the purpose of promoting energy efficiency in the industries through introduction of ISO Energy Management Standard incorporating industrial energy systems optimization.

4. Project objectives

The objective of the project is to promote industrial EE through adoption of ISO-based energy management standards and system optimization approach for improvement of the energy performance of industries to make its operations more reliable and competitive. The proposed project is designed to: i) increase the awareness and reinforce Thailand's efforts on the implementation of energy management system based on ISO 50001 to urge industrial enterprises to integrate EE as part of the management cycle for the realization of continuous energy savings, and ii) incorporate industrial energy systems optimization as a mean to maximize energy savings and reduce production costs.

The main project outcomes and outputs are:

1. ISO compliant energy management systems

The outcome from this component is to strengthen a policy instrument that encourages industrial enterprises to adopt ISO compatible energy management standards to deliver sustainable improvements in industrial energy efficiency, productivity and competitiveness. The Thai Industrial Standards Institute (TISI) will lead this component in close cooperation with the other main executing partners to ensure the sustainability of the project activities.

Outputs:

- Training material and tools on energy management developed
- National awareness campaign launched on ISO 50001
- National experts/factory personnel trained on ISO compliant energy management systems
- Peer-to-peer network between industrial enterprises established and operated

2. Industrial energy systems optimization

The main outcome from this component is the establishment of a cadre of energy efficiency professionals within industrial facilities as well as international experts and equipment suppliers to initiate a process to transform local markets effectively as to provide industrial systems optimization services.

Outputs:

- Training material and tools on systems optimization developed

- National experts/factory personnel trained on optimization of steam, compressed air, pumping and fans systems
- Equipment vendors/suppliers trained on systems optimization

3. Enhancement of IEE financing capacity

The outcome from this component is the increased availability of financial and institutional support for industrial energy efficiency initiatives. As the Department of Alternative Energy Development and Efficiency (DEDE) is supporting financing of energy efficiency projects in the country through its energy efficiency revolving fund since 2002, the proposed project will make use of existing market mechanisms to promote industrial energy efficiency projects. The project will target primarily on bridging the gaps in financial capacity of financial institutions/banks and build the capacity of industry to prepare more bankable energy efficiency proposals. The DEDE will lead this component of enhancement of industrial EE financing capacity through the following activities and outputs.

Outputs:

- Harmonized EE project evaluation criteria
- Capacity of banks/FIs enhanced on EE projects financing
- Training material developed and industry managers trained on the development of financial proposals

4. Implementation of energy management and systems optimization projects

The expected outcome from this component is the increased adoption of energy management standards and systems optimization energy efficiency projects by industries for higher energy savings on continuous basis.

Outputs:

- Energy management projects implemented
- Documented systems optimization demonstration projects
- Recognition program developed

5. Project implementation arrangements

The implementation of all the activities implemented by the project will be supervised by the Department of Industrial Promotion (DIP) through the Project Steering Committees (PSC). The DIP will coordinate overall direct project inputs from the other participating agencies and organizations according to the objectives and activities of the project. The DIP will designate one of high level officer to the Project Management Unit to act as National project Director (NPD) to guide the PMU in the implementation of the project. The PMU will be fully responsible for day to day activities of the project and will report to the UNIDO Project Manager. UNIDO will recruit the international teams responsible for delivering the tools, materials and trainings.

UNIDO and DIP in close collaboration with the other executing partners will assume the following responsibilities:

- Identification/approval of host factories to participate in the project and facilitate training sites
- Recognition program
- Delivery of case studies, documenting the energy savings and reductions in GHG emissions directly attributable to the project

6. Budget information:

Table 1 Financing plan summary - Outcome breakdown

Project outcomes/components	Donor (USD)	Co-Financing (USD)	Total (USD)
1 – ISO compliant energy management systems	965,000	985,000	1950
2 – Industrial energy systems optimization	1,239,500	405,000	406,739
3 - Enhancement of industrial EE financing capacity	262,000	200,000	462
4 - Implementation of energy management and systems optimization projects	668,500	13,350,000	681,85
Project management	360,000	685,000	1045
Monitoring and evaluation	125,000	20,000	145
Total	2382,239	2308,35	4690,589

Source: project document.

Table 2 Co-Financing source breakdown

Name of Co-financier (source)	Classification	Type	Total Amount (USD)
Ministry of Industry	National Government	Cash & in-kind	2,445,000
Ministry of Energy	National Government	Loan & in-kind	5,200,000
		<i>Loan</i>	<i>5,000,000</i>
		<i>In-kind</i>	<i>200,000</i>
SME Bank	Government-owned bank	Loan	3,000,000
CIMB Bank	Private bank	Loan	5,000,000
Total co-financing			15,645,000

Source: project document.

Table 3 UNIDO budget execution (starting from 2012)

Source: PROJECT DATABASE, December 2017.

Item	2012	2013	2014	2015	2016	2017	Total Expenditure (USD)
Contractual Services	3,374.88	37,203.49	185,690.5	249,966.44	41,347.99	22,600	825,18
Equipment	273,099.9	15,923.79	20,153.98	35,508	831.76	6,326	1444,009
International Meetings			707.88	1,411.21	527.67	17,239.35	1463,65
Local travel	8,878.44	17,986	6,519.22	21,770	15,651.91	9,389.64	301,193
Nat.Consult./Staff	84,060.65	99,027.79	114,922.98	132,695	128,594.78	131,165.35	1045,463
Other Direct Costs	32,921.48	22,973.36	36,689.86	36,926.78	35,184.52	22,908.40	527,601
Staff & Intern Consultants	119,005.5	283,730.35	369,173	355,426.22	228,984.97	27,621.67	1609,939
Staff Travel	9,116.65	8,764.15	6,613.38	4,384.56	6,637.24	10,030.28	271,544
Train/Fellowship/Study	45,733.24	55,181.88	30,919.45	55,307.93	48,653.79	13,957	578,75
Grand Total	576,190.74	540,790.81	771,390.25	893,396.14	506,414.63	261,237.69	8067,329

II. Evaluation purpose and scope

The purpose of the evaluation is to independently assess the two projects to help UNIDO improve performance and results of future programmes and projects.

The evaluation has two specific objectives:

- (i) Assess the project performance in terms of relevance, effectiveness, efficiency, sustainability and progress to impact;
- (ii) Develop a series of findings, lessons and recommendations for enhancing the design of new and implementation of ongoing projects by UNIDO.

The independent Terminal Evaluation (TE) will cover the whole duration of the project from their starting date in **3/1/2011** to the estimated completion date in **31/06/2018**.

III. Evaluation approach and methodology

The TE will be conducted in accordance with the UNIDO Evaluation Policy⁵⁰ and the UNIDO Guidelines for the Technical Cooperation project and project Cycle⁵¹.

⁵⁰ UNIDO (2015)

⁵¹ UNIDO (2006)

The evaluation will be carried out as an independent in-depth evaluation using a participatory approach whereby all key parties associated with the project will be informed and consulted throughout the evaluation. The evaluation team leader will liaise with the UNIDO Independent Evaluation Division (ODG/EVQ/IEV) on the conduct of the evaluation and methodological issues.

The evaluation will use a theory of change approach and mixed methods to collect data and information from a range of sources and informants. It will pay attention to triangulating the data and information collected before forming its assessment. This is essential to ensure an evidence-based and credible evaluation, with robust analytical underpinning.

The theory of change will identify causal and transformational pathways from the project outputs to outcomes and longer-term impacts, and drivers as well as barriers to achieve them. The learning from this analysis will be useful to feed into the design of the future projects so that the management team can effectively manage them based on results.

1. Data collection methods

Following are the main instruments for data collection:

- (a) **Desk and literature review** of documents related to the project, including but not limited to:
 - The original project document, monitoring reports (such as progress and financial reports, Mid-Term Review report, output reports, back-to-office mission report(s), end-of-contract report(s) and relevant correspondence.
 - Notes from the meetings of committees involved in the project.
- (b) **Stakeholder consultations** will be conducted through structured and semi-structured interviews and focus group discussion. Key stakeholders to be interviewed include:
 - UNIDO Management and staff involved in the project; and
 - Representatives of donors and counterparts.
- (c) **Field visit** to project sites in ?, Thailand and project management in Vienna, UNIDO HQ.
- (d) **Company-level survey.**

2. Evaluation key questions and criteria

The key evaluation questions are the following:

- (a) What are the key drivers and barriers to achieve the long term objectives? To what extent has the project helped put in place the conditions likely to address the drivers, overcome barriers and contribute to the long term objectives?
- (b) How well has the project performed? Has the project done the right things? Has the project done things right, with good value for money?
- (c) What have been the project's key results (outputs, outcome and impact, if possible)? To what extent have the expected results been achieved or are likely to be achieved against the project design? To what extent the achieved results will sustain after the completion of the project?
- (d) What lessons can be drawn from the successful and unsuccessful practices in designing, implementing and managing the project?

The evaluation will assess the likelihood of sustainability of the project results after the project completion. The assessment will identify key risks (e.g. in terms of financial, socio-political, institutional and environmental risks) and explain how these risks may affect the continuation of results after the project ends. Table 7 below provides the key evaluation criteria to be assessed by the evaluation. The details questions to assess each evaluation criterion are in annex 2.

Table 7 project evaluation criteria

	<u>Evaluation criteria</u>	<u>Mandatory rating</u>
A	Impact (or progress toward impact)	Yes
B	Project design	Yes
1	- Overall design	Yes
2	- Logframe	Yes
C	Project performance	Yes
1	- Relevance	Yes
2	- Effectiveness	Yes
3	- Efficiency	Yes
4	- Sustainability of benefits	Yes
D	Cross-cutting performance criteria	
1	- Gender mainstreaming	Yes
2	- M&E: ✓ M&E design ✓ M&E implementation	Yes
3	- Results-based Management (RBM)	Yes
E	Performance of partners	
1	- UNIDO	Yes
2	- National counterparts	Yes
3	- Donor	Yes
F	Overall assessment	Yes

3. Rating system

In line with the practice adopted by many development agencies, the UNIDO Independent Evaluation Division uses a six-point rating system, where 6 is the highest score (highly satisfactory) and 1 is the lowest (highly unsatisfactory) as per Table 8.

Table 8 project rating criteria

Score		Definition	Category
6	Highly satisfactory	Level of achievement clearly exceeds expectations and there is no shortcoming.	SATISFACTORY
5	Satisfactory	Level of achievement meets expectations (indicatively, over 80-95 per cent) and there is no or minor shortcoming.	
4	Moderately satisfactory	Level of achievement more or less meets expectations (indicatively, 60 to 80 per cent) and there are some shortcomings.	
3	Moderately unsatisfactory	Level of achievement is somewhat lower than expected (indicatively, less than 60 per cent) and there are significant shortcomings.	UNSATISFACTORY
2	Unsatisfactory	Level of achievement is substantially lower than expected and there are major shortcomings.	
1	Highly unsatisfactory	Level of achievement is negligible and there are severe shortcomings.	

IV. Evaluation process

The evaluation will be implemented in five phases which are not strictly sequential, but in many cases iterative, conducted in parallel and partly overlapping:

- i. Inception phase: The evaluation team leader will prepare the inception report providing details on the methodology for the evaluation and include an evaluation matrix with specific issues for the evaluation; the specific site visits will be determined during the inception phase.
- ii. Desk review and data analysis;
- iii. Interviews, survey and literature review;
- iv. Field visits;
- v. Data analysis and report writing.

V. Time schedule and deliverables

The evaluation is scheduled to take place from **April to July 2018**. The evaluation field mission to **?, Thailand** is tentatively planned for **May 2018**. At the end of the field mission, there will be a presentation of the preliminary findings for all stakeholders involved in this project.

After the evaluation field mission, the evaluation team leader will visit UNIDO HQ for debriefing and presentation of the preliminary findings of the Terminal Evaluation. The draft TE report will be submitted to UNIDO 3 weeks after the end of the mission. The draft TE report is to be shared with the UNIDO IEV, UNIDO Project Manager, the GEF and other stakeholders for comments and verification of factual and interpretation errors. The TE leader is expected to revise the draft TE report based on the comments received, edit the language and form and submit the final version in accordance with UNIDO ODG/EVQ/IEV standards.

Table 3 Tentative schedule

Timelines	Tasks
April 2018	Desk review and preparation of inception report
April 2018	Briefing with UNIDO Project Manager and experts based in Vienna – through Skype
May 2018	Field visits
End of May 2018	Debriefing in Vienna Preparation of first draft evaluation report
June 2018	Preparation of first draft evaluation report Internal peer review of the report by the UNIDO ODG/EVQ/IEV and other stakeholders' comments to draft evaluation report
July 2018	Final evaluation report

VI. Evaluation team composition

Each evaluation team will be composed of one international evaluation consultant acting as the team leader and one international consultant with expertise on industrial energy efficiency and speaking the local language. The evaluation team will possess relevant strong experience and expertise on evaluation and on industrial energy efficiency. Both consultants will be contracted by UNIDO.

The tasks of each team member are specified in the job descriptions annexed to these terms of reference. According to UNIDO Evaluation Policy, members of the evaluation team must not have been directly involved in the design and/or implementation of the project under evaluation. An evaluation manager from UNIDO ODG/EVQ/IEV will provide technical backstopping to the evaluation team and ensure the quality of the evaluation. The UNIDO Project Manager and National Project Teams will act as resourced persons and provide support to the evaluation team and the evaluation manager. The UNIDO Project Manager and the project team will provide logistical and administrative support the evaluation team to prepare for the field visits. The project team will provide a proposed list of stakeholders (e.g. government officials, private sector representatives and other relevant individuals) to the evaluation team who will make the final decision on who to consult. The project team will arrange the meetings and prepare field visit schedule for the evaluation team, following their request, prior to the field visit.

The evaluation team will maintain close liaison with the representatives of UNIDO, other UN agencies as well as with the concerned national agencies, and with national and international project staff. The evaluation team is free to discuss with the authorities concerned anything relevant to its assignment. However, it is not authorized to make any commitments on behalf of the Government, the donor or UNIDO.

VII. Reporting

Inception report

This Terms of Reference (ToR) provides some information on the evaluation methodology, but this should not be regarded as exhaustive. After reviewing the project documentation and initial

interviews with the Project Manager, the Team Leader will prepare, in collaboration with the team member, a short inception report that will operationalize the ToR relating to the evaluation questions and provide information on what type of and how the evidence will be collected (methodology). It will be discussed with and approved by the responsible UNIDO Evaluation Manager.

The Inception Report will focus on the following elements: preliminary project theory model(s); elaboration of evaluation methodology including quantitative and qualitative approaches through an evaluation framework (“evaluation matrix”); division of work between the team leader and team members; mission plan, including places to be visited, people to be interviewed and possible surveys to be conducted and a debriefing and reporting timetable.⁵²

Evaluation report format and review procedures

The draft report will be delivered to ODG/EVQ/IEV (the suggested report outline is in Annex 4) and circulated to UNIDO staff and national stakeholders associated with the project for factual validation and comments. Any comments or responses, or feedback on any errors of fact to the draft report provided by the stakeholders will be sent to UNIDO ODG/EVA for collation and onward transmission to the project evaluation team who will be advised of any necessary revisions. On the basis of this feedback, and taking into consideration the comments received, the evaluation team will prepare the final version of the Terminal Evaluation report.

The evaluation team will present its preliminary findings to the local stakeholders at the end of the field visit and take into account their feedback in preparing the evaluation report. A presentation of preliminary findings will take place at UNIDO HQ after the field mission.

The TE report should be brief, to the point and easy to understand. It must explain the purpose of the evaluation, exactly what was evaluated, and the methods used. The report must highlight any methodological limitations, identify key concerns and present evidence-based findings, consequent conclusions, recommendations and lessons. The report should provide information on when the evaluation took place, the places visited, who was involved and be presented in a way that makes the information accessible and comprehensible. The report should include an executive summary that encapsulates the essence of the information contained in the report to facilitate dissemination and distillation of lessons.

Findings, conclusions and recommendations should be presented in a complete, logical and balanced manner. The evaluation report shall be written in English, with an executive summary in English, and follow the outline given in annex 1.

VIII. Quality assurance

All UNIDO evaluations are subject to quality assessments by UNIDO ODG/EVQ/IEV. Quality assurance and control is exercised in different ways throughout the evaluation process (briefing of consultants on methodology and process of UNIDO ODG/EVQ/IEV, providing inputs regarding findings, lessons learned and recommendations from other UNIDO evaluations, review of inception report and evaluation report by UNIDO ODG/EVQ/IEV).

⁵² The evaluator will be provided with a Guide on how to prepare an evaluation inception report prepared by the UNIDO ODG/EVQ/IEV.

Annex II. Evaluation framework

The quality of the evaluation report will be assessed and rated against the criteria set forth in the Checklist on evaluation report quality, attached as Annex 4. The applied evaluation quality assessment criteria are used as a tool to provide structured feedback. UNIDO ODG/EVQ/IEV should ensure that the evaluation report is useful for UNIDO in terms of organizational learning (recommendations and lessons learned) and is compliant with UNIDO's evaluation policy and these terms of reference. The draft and final evaluation report are reviewed by UNIDO ODG/EVQ/IEV, which will submit the report to the donor and circulate it within UNIDO together with a management response sheet.

Evaluation framework	Evaluation criteria	Data source(s)
A	Impact (or progress toward impact)	Interviews, PMU (2018) Final Report
B	Project design	
1	Overall design	GEF CEO Endorsement, Stakeholder Interviews
2	Logframe	GEF CEO Endorsement
C	Project performance	
1	Relevance	Stakeholder Interviews (national counterparts, UNIDO, PMU)
2	Effectiveness	PMU (2018) Final Report
3	Efficiency	PMU (2018) Final Report, Stakeholder Interviews (national counterparts, UNIDO, PMU)
4	Sustainability of benefits	Interviews (beneficiaries, national counterparts, UNIDO, PMU)
D	Cross-cutting performance criteria	
1	Gender mainstreaming	PMU (2018) Final Report, Interviews with female participants
2	M&E: - M&E design - M&E implementation	Interviews (PMU)
3	Results-based Management (RBM)	PMU Progress Reports
E	Performance of partners	
1	UNIDO	Stakeholder Interviews (national counterparts, PMU)
2	National counterparts	Stakeholder Interviews (UNIDO, PMU)
3	Donor	Stakeholder Interviews (national counterparts, UNIDO, PMU)
F	Overall assessment	Summary of Findings

Source: own compilation.

Annex III. List of documentation reviewed

- AJA (2018) ISO 50001 (Accredited by ANAB). <http://ajathailand.com/standard/50001/>.
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- ClimateWatch (2018) Country Comparison. https://www.climatewatchdata.org/countries/compare?calculation=PER_CAPITA&locations=THA%2CMYS%2CVNM.
- Bureau of Energy Human Resource Development [BEHRD] (n.d.) Training Courses. http://www2.dede.go.th/bhrd/old/courseappthai_eng.html.
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<http://www.oecd.org/development/peer-reviews/2754804.pdf>.
- Organisation for Economic Co-operation and Development / International Energy Agency [OECD / IEA] (2017a) Tracking fossil fuel subsidies in APEC economies – Toward a sustained subsidy reform.
- Organisation for Economic Co-operation and Development / International Energy Agency [OECD / IEA] (2017b) Southeast Asia Energy Outlook 2017.
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- Pichalai, C. (2015) Thailand Energy Efficiency Development Plan. [http://www.asew-expo.com/Portals/0/seminar/Presentation/03-Overview%20of%20Energy%20Efficiency%20Development%20Plan%20\(EEDP%202015\).pdf](http://www.asew-expo.com/Portals/0/seminar/Presentation/03-Overview%20of%20Energy%20Efficiency%20Development%20Plan%20(EEDP%202015).pdf).
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Annex IV. List of interviewees

Table 9 List of interviewees

Organisation/ Institution	Role in the project	Contact
Aeroflex Co. Ltd.	Participating company	Management representatives
Charoen Pokphand Foods (CPF)	Participating company	Management representatives
Department of Alternative Energy Development and Efficiency (DEDE)	Member of the Project Steering Committee	Mr. Pongpan Worasayan, Energy Efficiency Expert
DIP	Chair of the Project Steering Committee	Mr. Jaruphun Jarayophat, Deputy Director General, Mr. Worawit Jirattiticharoen , Industrial Technical Officer, project Focal point
Eastern Polypack Co., Ltd.	Participating company	Management representatives
EnMS National Experts	Experts trained by the project	Dr. Somchai Dechapanichkul Mr. Pitoon Jantip
Federation of Thai Industries (FTI)	Member of the Project Steering Committee	Ms. Luxkhana Thitithamrongchai, Assistant Manager
King Mongkut's University of Technology Thonburi (KMUTT)		Dr. Surachai Sanitjai Dr. Atikorn Wongsatanawarid Dr. Wasan Yoksenakul
Saha Pathana Inter-Holding	Non-intervention company	Management representatives
SME Bank	Member of the Project Steering Committee	Mr. Pornchai Jirasopon, Acting Deputy Vice President, Product Development Department
System Optimization National Experts	Experts trained by the project	Mr. Kran Rakcharoen Mr. Suchai Pongpakpien Mr. Rawit Taweewup Ms. Manchima Chatsrirung
Thai Industrial Standard Institute (TISI)	Member of the Project Steering Committee	Mrs. Sutavadee Techajunta, Expert of Technical Regulation Ms. Witchar Pichainarong, Standard Officer
UNIDO PMU	Project team	Mr. Sanjaya Shrestha Uma Wirutskulshai Atchareeya Pongput, project Assistant Nuttawut Chuenarom Mr. Ampol Somboonphokaphan, project Assisstant

Source: Mission Plan.

Annex V. Project logframe

Project Narrative	Indicator	Baseline	Target	Sources of Verification	Assumptions/Risks
<p>Project Objective</p> <p>Promote energy efficiency in the industries through introduction of ISO energy management standard incorporating industrial system optimization</p>	<ul style="list-style-type: none"> Measurable reductions in electricity and fuel consumption by industry Calculated GHG emissions reductions 	<p>No direct and indirect electricity and fuel consumption reductions</p> <p>Baseline values to be determined through data collection and discussions with industry</p>	<p>Electricity savings: 83,712 MWh,</p> <p>Fuel savings of 1,914,142 GJ</p> <p>Emissions reduction of 196,757 tCO₂ during the project duration (to be determined after technical assessments during the project implementation)</p>	<p>Terminal reports</p> <p>Peer-to-peer network</p> <p>End-of-project survey</p>	<p>Continuous support of concerned government authorities</p> <p>Active support driven by industry</p>
<p>Component 1: ISO compliant energy management systems</p>					
<p>Outcome 1: Compliance to a policy instrument that encourages industrial enterprises to adopt ISO compatible energy management standards to deliver sustainable improvements in industrial energy efficiency and competitiveness</p>					
<p>Output 1.1: Training material and tools on energy management developed</p>	<p>Training material on energy management systems provided to industrial enterprises.</p>	<p>Continued use of generic training material on energy management in industrial facilities.</p>	<p>Availability of translated, comprehensive training material and tools specifically supporting the development and implementation of energy management compatible with ISO 50001.</p>	<ul style="list-style-type: none"> UNIDO experts' reports Project progress reports 	<p>Continuous government and industry sector support and participation</p>
<p>Output 1.2: National awareness campaign launched on ISO 50001</p>	<p>National campaign provided information to industry to adopt ISO 50001.</p>	<p>Limited awareness campaign launched on energy management standard in the past.</p>	<p>Promotional literature distributed to industries to promote the adoption of ISO 50001.</p>	<ul style="list-style-type: none"> Awareness campaign report Progress and annual reports 	<p>Sustained government support and participation</p>

Project Narrative	Indicator	Baseline	Target	Sources of Verification	Assumptions/Risks
Output 1.3: National experts/factory personnel trained on energy management systems	<ul style="list-style-type: none"> • Number of trained national experts • Number of trained factory personnel 	Current/proposed training programs limited to generic aspects of energy management without comprehensive guidelines and not specifically addressing content of ISO 50001	Training on energy management in line with ISO 50001 of: <ul style="list-style-type: none"> • 50 national experts • 500 factory managers (out of which 300 will be trained in energy management system implementation) 	Reports of UNIDO's international experts and list of attendees	Sufficient commitment to energy management on the part of national experts and factory personnel
Output 1.4: Peer-to-Peer network between industrial enterprises created and operational	Network established and used to support program recognition and present savings result from energy management.	Government database only, no formal peer-to-peer discussion platforms on energy management exist.	All participating enterprises share their implementation plan on energy management on the network and learn from others' experience and results	Annual report on web-based participating facility results	Willingness to upload their experience with energy management (EE measures and projects undertaken)
Component 2: Industrial energy systems optimization					
Outcome 2: A cadre of energy efficiency professionals created within industrial facilities as well as consultants and suppliers to initiate a process to transform local markets effectively and to provide industrial systems optimization services					
Output 2.1: Training material and tools on systems optimization developed	Training material on systems optimization provided to industrial enterprises.	Continued use of generic IEE training material focusing on energy audits and specific sectors, but generic technology replacement opportunities.	Availability of translated, comprehensive training material and tools on systems optimization	<ul style="list-style-type: none"> • UNIDO experts' reports • Project progress and annual reports 	Continuous government support and participation
Output 2.2: National experts/factory personnel trained on optimization of steam, compressed air, fan and pumping systems	<ul style="list-style-type: none"> • Number of trained national experts • Number of trained factory personnel 	Current/proposed training programs (both national and donor-supported) do not address systems optimization.	Training in systems optimization of: <ul style="list-style-type: none"> • 50 national experts • 400 factory managers 	<ul style="list-style-type: none"> • Reports of UNIDO's international experts • List of training sessions attendees 	Sufficient commitment to systems optimization on the part of national experts and factory personnel

Project Narrative	Indicator	Baseline	Target	Sources of Verification	Assumptions/Risks
Output 2.3: Equipment vendors/suppliers trained on systems optimization	Number of trained equipment vendors/suppliers	Continued exclusive focus by vendors on the sale of individual equipment items. Least purchase price continues to be the main driver for purchasers of steam boilers, pumps, and air compressors.	Training of 50 equipment suppliers/vendors of energy-efficient products in systems optimization	<ul style="list-style-type: none"> • Reports of UNIDO's international experts • List of training session attendees 	Sufficient commitment to systems optimization on the part of equipment suppliers
Component 3: Enhancement of industrial EE financing capacity development					
Outcome3: Increased availability of financial and institutional support for industrial energy efficiency initiatives					
Output 3.1: Harmonized EE project evaluation criteria	Evaluation criteria are harmonized within financial institutions to help them select best EE projects.	Financial institutions continue to appraise EE projects without standards and recognized criteria using current bank projects evaluation criteria.	Criteria for evaluating EE projects are developed and harmonized by main financial institutions in Thailand	<ul style="list-style-type: none"> • Project progress reports • UNIDO experts' reports 	Sufficient commitment from financial institutions to change the way they currently evaluate EE projects
Output 3.2: Trainings provided to banks/FIs on EE projects financing	Number of financial institutions and local banks personnel trained to understand main features of EE projects and better appraise EE projects proposals.	Weak capacity of financial institutions and local banks to understand and evaluate EE projects.	Strengthened capacity of financial institutions and local banks on EE projects evaluation	<ul style="list-style-type: none"> • Training sessions report • Project progress reports • Attendance list 	Financial institutions and local banks are committed enough to build their capacity and invest in EE projects

Project Narrative	Indicator	Baseline	Target	Sources of Verification	Assumptions/Risks
Output 3.3: Training material developed and industry managers trained on the development of financial proposals	<p>Training material relating to financing of energy efficiency project development are provided to industries.</p> <p>Number of trained facility managers/personnel in industrial energy efficiency project development.</p>	<p>No specific material existed to help industrial managers prepare financially sound proposals to mobilize the necessary funds from financiers and banks management.</p> <p>Continued use of generic methods, which do not properly consider the financial impact and opportunities of EE in facilities.</p>	<p>Availability of translated, comprehensive material and guidelines specifically supporting the development of financial proposals for EE projects</p> <p>Industrial facility managers/personnel have the capacity to analyse systems optimization and energy management projects and use energy and O&M costs reduction projects</p>	<ul style="list-style-type: none"> • Project progress reports • UNIDO experts' reports • List of attendees 	Sufficient commitment from facility managers to take action on project financial development
Component 4: Implementation of energy management and systems optimization projects					
Outcome 4: Demonstrable energy savings in participating factories through systems optimization and energy management standards and increased adoption of energy management standards by industry					
Output 4.1: Energy management systems implemented	<ul style="list-style-type: none"> • Number of factories with energy management plans implemented • Number of case studies • Number of factories registered for peer-to-peer network 	Limited implementation of energy management systems in Thailand, leaving its (export) industry unprepared for potential market demand for energy-efficient production of goods for export.	<ul style="list-style-type: none"> • 200 factories adopted energy management plans and completed operational improvement projects • 50 factories adopted and implemented ISO 50001 • Participating factories registered with the peer-to-peer network report energy savings 	<ul style="list-style-type: none"> • Case studies from national experts that have received training • Reports of UNIDO's international experts 	<ul style="list-style-type: none"> • Continuous support from the National Standardization Agency and the government • Sufficient interest from industry • Successful introduction of peer-to-peer network

Project Narrative	Indicator	Baseline	Target	Sources of Verification	Assumptions/Risks
Output 4.2: Documented systems optimization demonstration projects	<ul style="list-style-type: none"> • Number of completed steam, pumping, fan and compressed air systems assessments • Number of completed systems optimization projects 	Absence of local examples of successful optimization of industrial steam, pumping, and compressed air systems hindering nationwide uptake of good EE practices.	<ul style="list-style-type: none"> • 75 systems assessments conducted of which 50 led to completed systems optimization projects • 25 case studies showing GHG emission reductions 	<ul style="list-style-type: none"> • Case studies from national experts • Reports of UNIDO's international experts 	Sufficient commitment from industrial enterprises to take action on systems optimization following systems assessment
Output 4.3: Recognition program developed and implemented	Recognition program for participating companies established based on successful achievements	Ad-hoc publicity for EE success stories from the industry.	Formal recognition of factories achieving power/fuel consumption reductions reflected in government reports	<ul style="list-style-type: none"> • Award ceremony highlighting successful projects • Project annual reports 	Continuous government support for a recognition program

Source: GEF (2010a).

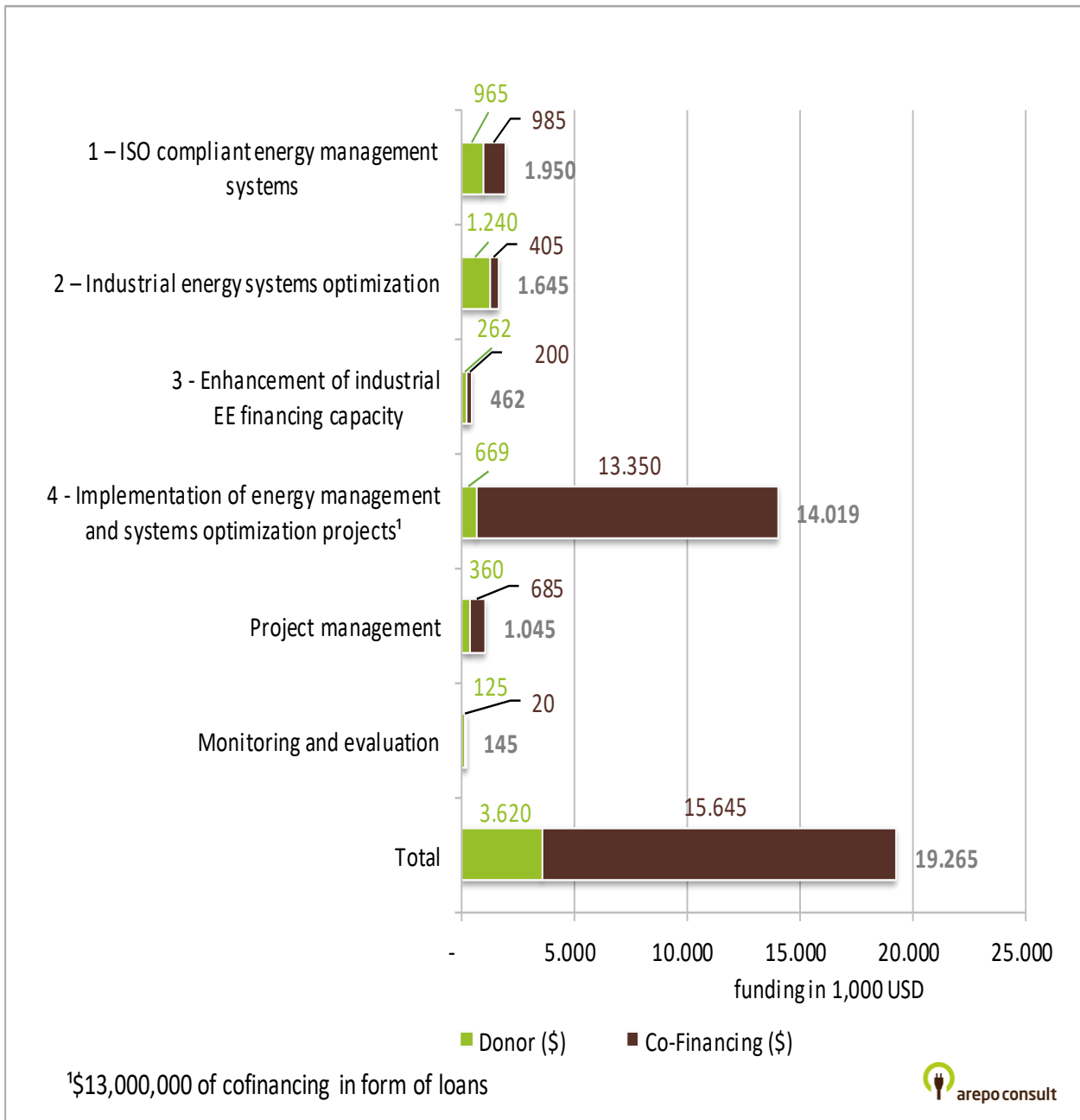
Annex VI. Additional data and information

Table 10 Course offer of the Bureau of Energy Human Resource Development (BEHRD)

Course	Content (examples)
1. Training Courses on Energy Management for Efficient Energy Conservation in Factory and Building	<ul style="list-style-type: none"> - Electricity Management Course - Thermal Energy Management Course - Person Responsible for Energy (PRE) Course in Designated Buildings, 3 Sessions - PRE Course in Designated Factories, 3 Sessions - Basic Course for Energy Operators / Staff in the 4th Year Designated Factories - Energy Conservation in Factory and Building - PRE Course: Ordinary - PRE Course: Senior - Energy Conservation by Practice (Mini Plant) - ESCO project Administration in Thailand - Energy Manager Course - Monitoring and Assessment of Energy Consumption - Energy Audit and Establishment of Energy Conservation Plan and Target - Energy Seminar for Building and Factory Owners/Executives
2. Training Courses on Energy Technology for Energy Conserving Material, Equipment and Machinery	<ul style="list-style-type: none"> - Air Conditioner Control - Energy Savings and Steam Boiler Maintenance in Factory - Energy Savings and Air Compressor Maintenance in Factory - Energy Audit in Large Air Conditioner for Energy Conservation - Supporting the Knowledge and Advice on Equipment Operation and Maintenance in Government Buildings - Heat Recovery - Refrigeration System - Lighting System - Motor
3. Training Courses on Energy End-Use System by Designated Factory Classifications	<ul style="list-style-type: none"> - Energy Conservation in Food Industry - Energy Conservation in Textile Industry - Energy Conservation in Ice Making Plant - Energy Conservation in Metallic Industry - Energy Conservation in Glass Industry - Energy Conservation in Paper and Pulp Industry - Energy Conservation in Tile Industry
4. Training Courses on Energy End-Use System by Categories of Designated Building	<ul style="list-style-type: none"> - Energy Conservation in Hotel - Energy Conservation in Hospital - Energy Conservation in Office Building and Department Store
5. Training at Educational Institutes	<ul style="list-style-type: none"> - Through developing the courses and organising the training for teachers-lecturers who will be the ones to transfer the knowledge and skill on - Energy conservation to students whose future professions are of energy managers, engineers, and technicians in factories and buildings. - Electricity Conservation Course for Vocational Instructors - Thermal Energy Conservation Course for Vocational Instructors - Training project on Energy Conservation in Factory/Building for the Final Year Students in bachelor's Degree - Energy Management for Vocational Education

Source: BEHRD (n.d.).

Figure 16 Original project budget per project component (in USD 1.000)



Source: own graph based on GEF (2010a).

Table 11 projects results, target and target achievement

Project components/ outcomes	Project outputs	Target in project document	Target achievement	Target achievement in %
Project Objective Promote energy efficiency in the industries through introduction of ISO energy management standard incorporating industrial system optimization	Measurable reductions in electricity and fuel consumption by industry	Electricity savings: 83,712 MWh,	Electricity savings:111,307 MWh	133 %
		Fuel savings of 1,914,142 GJ	Fuel savings of 2,713,001 GJ	142 %
	Calculated GHG emissions reductions	Emissions reduction of 196,757 t CO ₂ during the project duration	Emissions reduction of 247,047 t CO ₂	126 %
Component 1: ISO compliant energy management systems Outcomes: - Compliance to a policy instrument, compatible with ISO energy management standard, in place delivering sustainable improvements in energy efficiency in industry and improved productivity and competitiveness systems optimization	1.1. Training material and tools on energy management developed	Availability of translated, comprehensive training material and tools specifically supporting the development and implementation of energy management compatible with ISO 50001.	“done”	n/a
	1.2. National awareness campaign launched on ISO 50001	Promotional literature distributed to industries to promote the adoption of ISO 50001.	“done”	n/a
	1.3. National experts / factory personnel trained on ISO compliant energy management systems	Training on energy management in line with ISO 50001 of: 50 national experts	Training on energy management in line with ISO 50001 of: 62 national experts trained on EnMS	124 %
		500 factory managers (out of which 300 will be trained in energy management system implementation)	EnMS Training: 612 managers attended management workshop (364 factories sent their personnel to EnMS user training)	122 %
	1.4. Peer-to-peer network between industrial enterprises established and operated	All participating enterprises share their implementation plan on energy management on the network and learn from others' experience and results	“done”	n/a

Project components/ outcomes	Project outputs	Target in project document	Target achievement	Target achievement in %
Component 2: Industrial energy Outcome 2: - A cadre of energy efficiency professionals created both within industrial facilities as well as consultants and suppliers to initiate a process to transform local markets effectively for providing industrial systems optimization services	2.1. Training material and tools on systems optimization developed	Availability of translated, comprehensive training material and tools on systems optimization	"done"	n/a
	2.2. National experts / factory personnel trained on optimization of steam, compressed air, pumping and fans systems	Training in systems optimization of: 50 national experts	Training in systems optimization of: 48 national experts trained on SO	96 %
		400 factory managers ⁵³	344 factories (1,126 factory personnel attended SO user training)	282 %
	2.3. Equipment vendors / suppliers trained on systems optimization	Training of 50 equipment suppliers/ vendors of energy-efficient products in systems optimization	60 equipment suppliers / vendors of energy-efficient products trained on SO	120 %
Component 3: Enhancement of industrial EE financing capacity Outcome 3: - Increased availability of financial and institutional support for industrial energy efficiency initiatives	3.1. Harmonized EE project evaluation criteria	Criteria for evaluating EE projects are developed and harmonized by main financial institutions in Thailand	"Report Completed"	n/a
	3.2. Capacity of banks/ financial institutions enhanced on EE projects financing	Strengthened capacity of financial institutions and local banks on EE projects' evaluation	87 factory personnel from 40 factories 34 bank personnel from 9 banks	No quantitative targets defined
	3.3. Training material developed, and industry managers trained on the development of financial proposals	Availability of translated, comprehensive material and guidelines specifically supporting the development of financial proposals for EE projects Industrial facility managers/personnel have the capacity to analyse systems optimization and energy management projects and use energy and O&M costs reduction projects.	"done"	n/a

⁵³ Target was originally defined as "factory managers," but most likely referred to factory personnel.

Project components/ outcomes	Project outputs	Target in project document	Target achievement	Target achievement in %
Component 4: Implementation of energy management and systems optimization projects Outcome 4: - Demonstrable energy savings in participating factories through systems optimization and energy management standards and increased adoption of energy management standards by industry	4.1. Energy management projects implemented	200 factories adopted energy management plans and completed operational improvement projects	200 factories with energy management plans	100 %
		50 factories adopted and implemented ISO 50001	50 factories with energy management system in place (out of which 25 received ISO 50001 certification)	100 %
		Participating factories registered with the peer-to-peer network report energy savings	"done"	n/a
		75 systems assessments conducted of which 50 led to completed systems optimization projects	76 system optimization assessments carried out of which 74 led to completed system optimization projects	101 %
	4.2. Documented systems optimization demonstration projects	25 case studies showing GHG emission reductions Formal recognition of factories achieving power / fuel consumption reductions reflected in government reports	12 case studies on EnMS and 13 case studies on SO published	100 %
	4.3. Recognition program developed	Set up energy performance indicators for recognizing improvement on energy efficiency in the peer-to-peer networks DIP and DEDE recognizes industries through the awards based on the energy saving performance indicators	"done"	n/a

Source: project documents, PMU (2018).

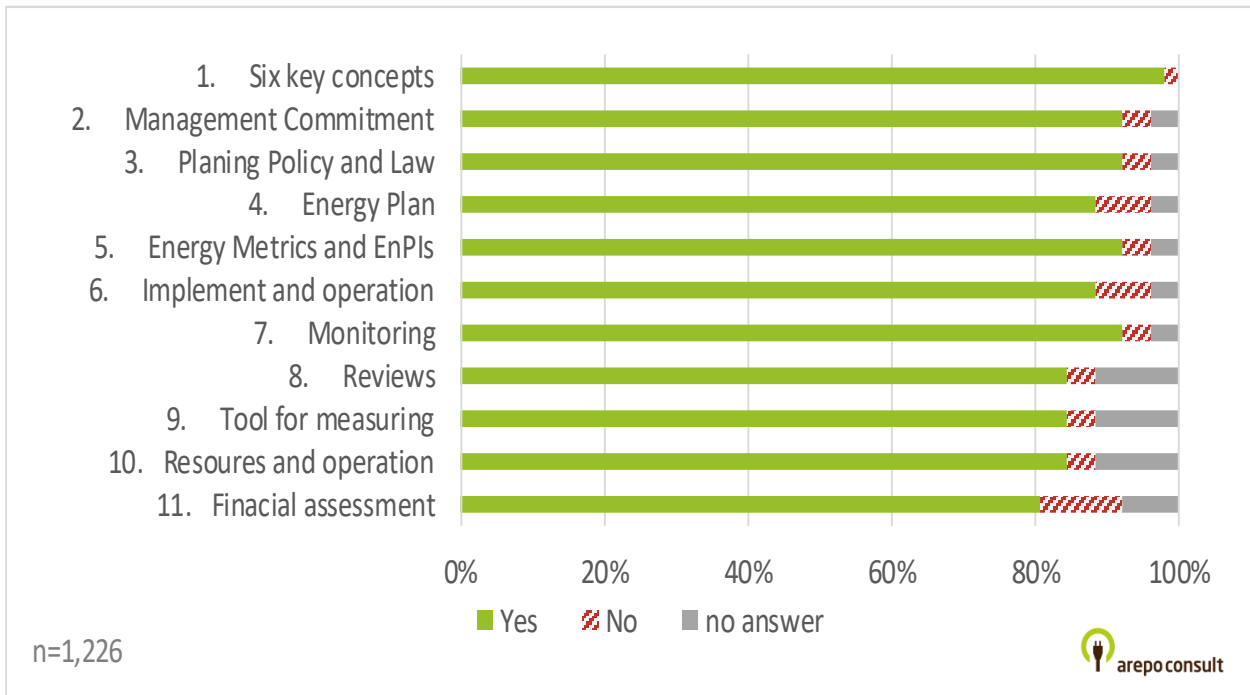
Table 12 Number of companies that participated in project activities for which energy saving could be verified

IEE project activity	Verified energy savings	Verification source
Direct savings ^[1]		
<i>Output 4.2:</i> Energy savings from the factories conducting system optimization assessment under the project's support (direct savings)	76 assessments carried out, savings were verified for 29 companies.	Final project Report. Annex. Table f.6
<i>Output #:</i> Energy savings from the factories implementing EnMS under the project's support (direct savings)	21 companies implemented 75 EnMS measures	Final project Report. Annex. Table f.2
TOTAL: All measures implemented with the IEE project's direct support	44 companies	Final project Report. Annex. Table d.1
Indirect savings		
<i>Output 4.1:</i> Energy savings measures implemented according to Energy Management Plan in place (indirect savings)	172 measures implemented by 52 companies	Final project Report. Annex. Table f.4
<i>Output 2.2:</i> Energy savings measures implemented by the factories sending their personnel to attend SO trainings (indirect savings)	344 companies sent their staff, savings verified for 42 companies.	Final project Report. Annex. Table f.7
<i>Output 4.1:</i> Energy savings from EnMS implementation	50 factories implemented an energy management system	Final project Report. Annex. Table f.1
TOTAL indirect savings: <i>Output 1.3:</i> Energy savings implemented by the factory staff that was sent to attend 2-day user trainings	94 companies sent their staff, 276 measures were implemented	Final project Report. Annex. Table d.2

^[1] The direct support from the project consisted of the expert training for host facility and candidate plant, the EnMS implementation and the system optimization assessment.

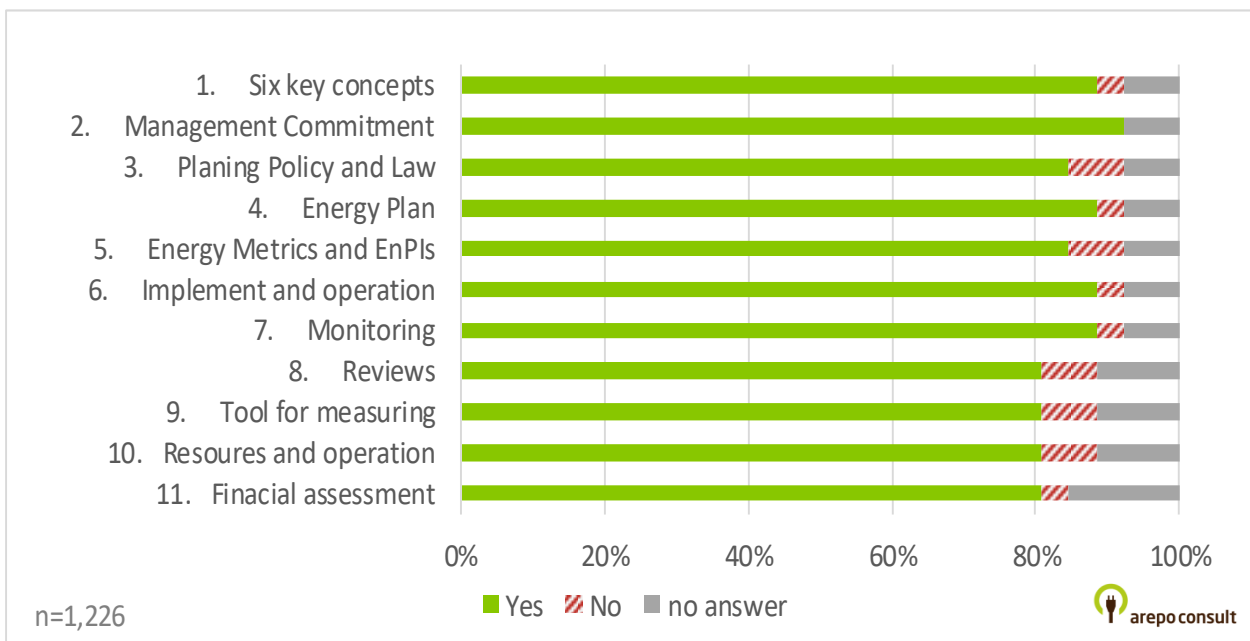
Source: Final Report Annex.

Figure 17 PMU Survey of EnMS user training: Did the training material provide sufficient details?



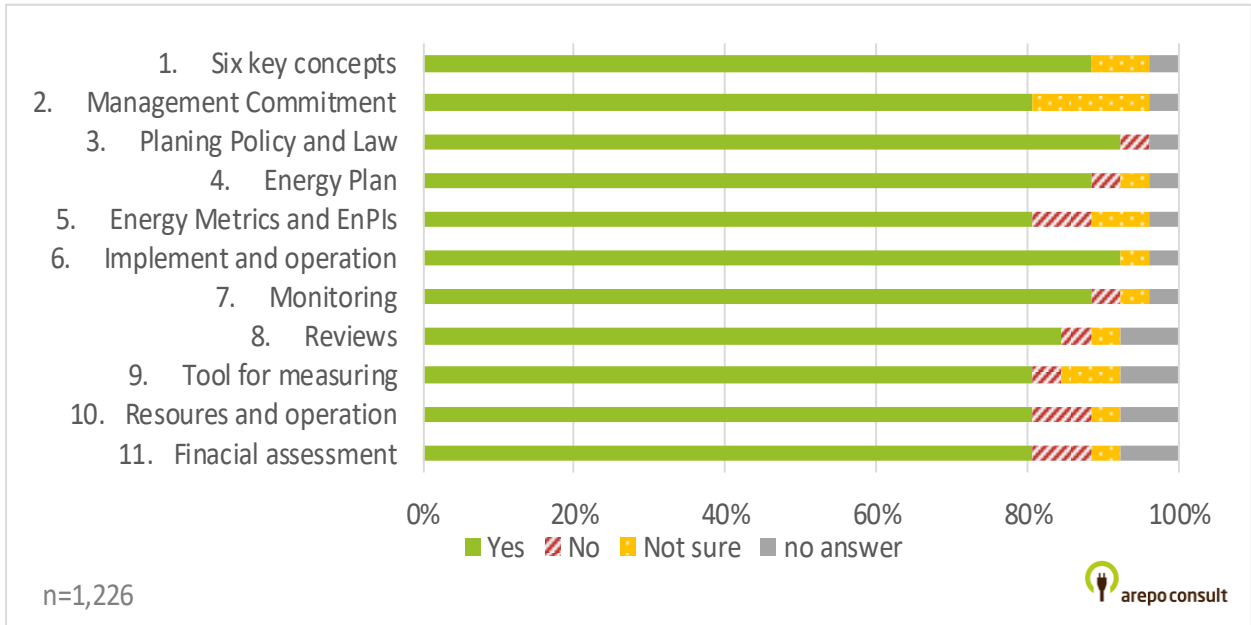
Source: PMU Survey of EnMS user training.

Figure 18 PMU Survey of EnMS user training: Did the trainer's presentation help you understand the course content?



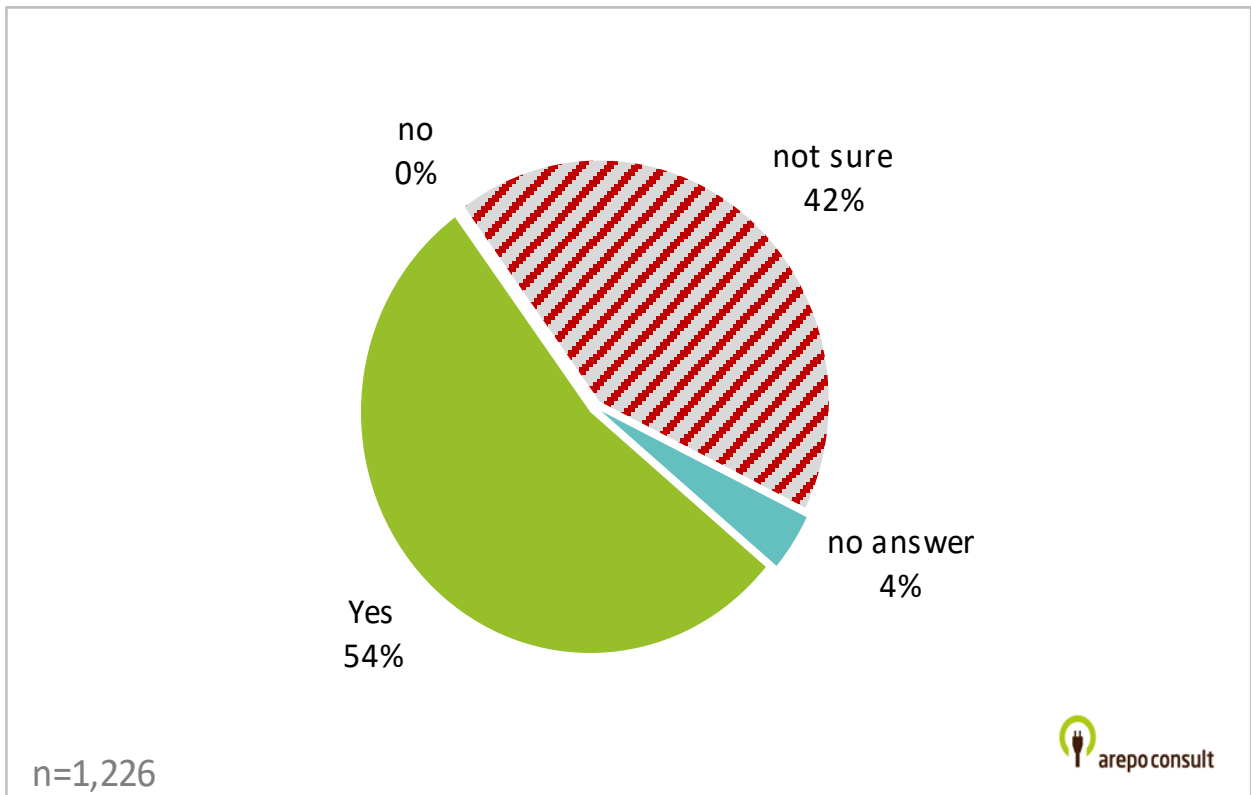
Source: PMU Survey of EnMS user training.

Figure 19 PMU Survey of EnMS user training: Can you use the training content at your factory?



Source: PMU Survey of EnMS user training.

Figure 20 PMU Survey of EnMS user training: Have you implemented an EnMS at your factory site?



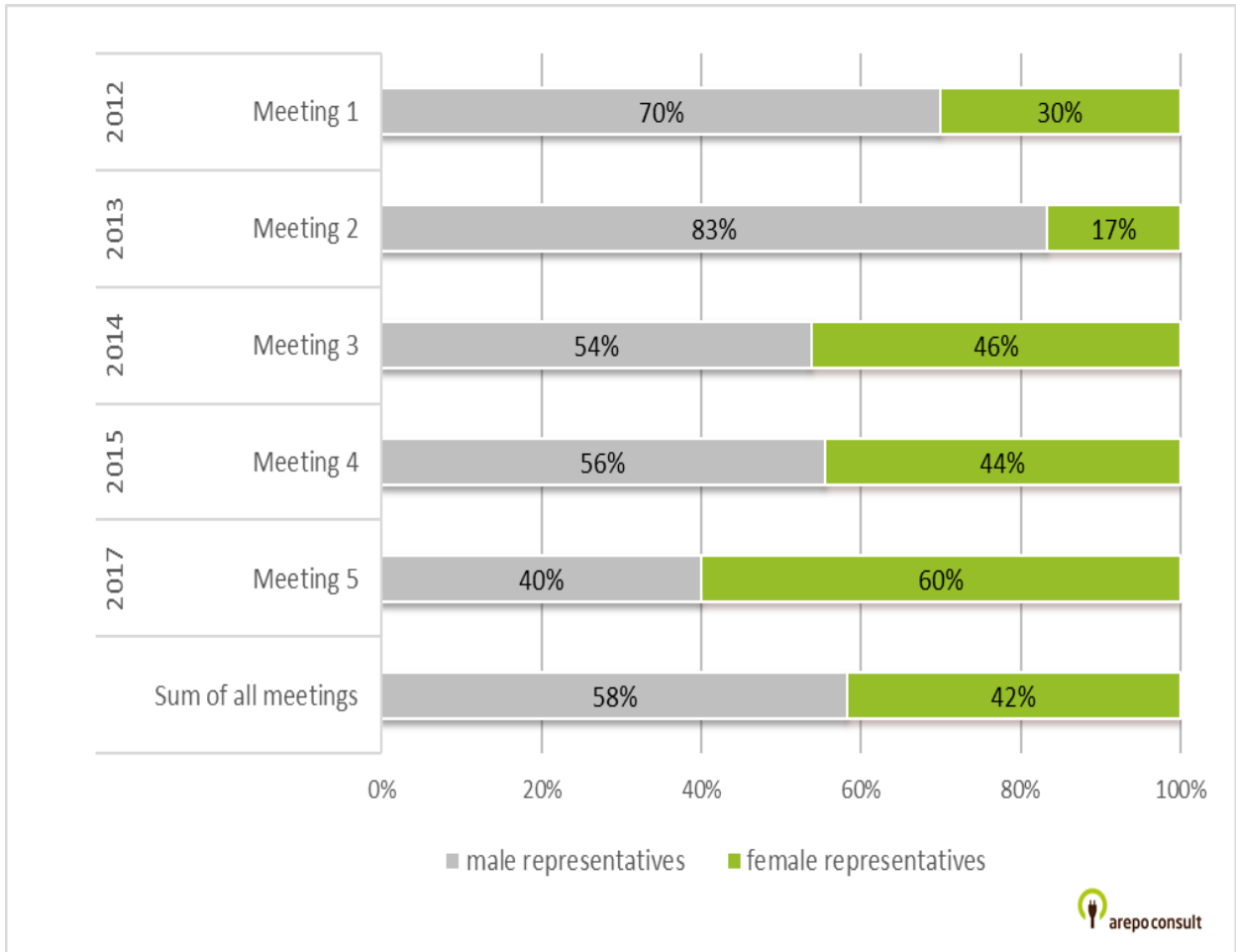
Source: PMU Survey of EnMS user training.

Table 13 Assumptions / Risks from the project Results Framework sorted by stakeholder group

Stakeholder	Assumptions / Risks from the project Results Framework
Government	<ul style="list-style-type: none"> - Continuous support of concerned government authorities (Project objective) - Sustained government support and participation (Output 1.1) - Continuous government support and participation (Output 2.1) - Continuous government support for a recognition program (Output 4.3) - Continuous support from the National Standardization Agency and the government (Output 4.1)
Industry/Factory management	<ul style="list-style-type: none"> - Active support driven by industry (Project objective) - Continuous industry sector support and participation (Output 1.1) - Willingness to upload their experience with energy management (EE measures and projects undertaken) (Output 1.4) - Sufficient interest from industry (Output 4.1) - Successful introduction of peer-to-peer network (Output 4.1) - Sufficient commitment from industrial enterprises to take action on systems optimization following systems assessment (Output 4.2)
Individual consultants and factory personnel	<ul style="list-style-type: none"> - Sufficient commitment to energy management national (Output 1.3) - Sufficient commitment to systems optimization (Output 2.1) - Sufficient commitment from facility managers to take action on project financial development (Output 1.1)
Equipment suppliers	<ul style="list-style-type: none"> - Sufficient commitment to systems optimization (Output 2.3)
Financial Institutions	<ul style="list-style-type: none"> - Sufficient commitment from financial institutions to change the way they currently evaluate EE projects (Output 3.1) - Financial institutions and local banks are committed enough to build their capacity and invest in EE projects (Output 3.2)

Source: GEF (2010a).

Figure 21 Gender composition of the representatives of members in the Steering Committee meetings



Source: own graph.