



**TOGETHER**  
*for a sustainable future*

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UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION

The UNIDO Programme on  
**Energy Management  
System Implementation  
in Industry**





## Introduction

The overarching objective of the post-2015 sustainable development framework is to create a global pathway to sustainable development and eradicate extreme poverty by 2030, while responding to the new global challenges. Structural transformation through industrialization will continue to be the main driver of poverty reduction and wealth creation in the post-2015 world. However, to achieve poverty-reducing, inclusive and sustainable industrial development (ISID), we need to capture the positive “nexus” between the multiple interdependent factors that define today’s economic and environmental development paths and facilitate their positive interactions and synergies at all levels. This is what we need to pursue in order to reconcile the creation of new wealth and prosperity with the sustainability of future generations.

Today industry accounts for more than a third of global energy consumption and greenhouse gas emissions and will continue to drive the growth of global energy demand over the coming decades, particularly in developing and emerging economies. In order to decouple industrial development and economic growth from energy consumption and the associated environmental and climate change impacts, industry needs to substantially increase its energy efficiency and progressively switch from carbon-intensive to low-carbon and low-emission technologies.

While the challenge remains daunting, there are policies, technologies, best practices and other instruments available to industry, policymakers and the international community to support and undertake actions. The immediate need is to accelerate the global dissemination and implementation of existing best available technologies and practices. It is estimated that by doing so, industry could cut its global energy consumption by over 25 per cent.

By scaling up the deployment of industrial energy management systems (EnMSs) and standards, UNIDO helps countries at all levels of development to improve the overall efficiency of their manufacturing sectors, while also achieving cost-effective reduction of greenhouse gas (GHG) emissions. Industry experience around the world has shown that companies can save around 10-20 per cent of their annual energy consumption and reduce their costs through better energy management, often by just making operational changes with minimal or no investment.

## The need for energy management systems in industry

Time and again, energy efficiency has been demonstrated to be cost-effective while having a positive effect on productivity in the industrial sector. Despite this, energy efficiency improvements with no-cost or very favourable payback periods often do not get implemented. Even in cases where projects are implemented, results are often not sustained due to a lack of supportive operational and maintenance practices. Unfortunately, energy efficiency is still widely viewed as a luxury rather than a strategic investment in future profitability.

The evidence from three decades of national and international experience with industrial energy efficiency programmes shows that energy efficiency in industry depends more on how energy is managed than on the simple installation of new technologies.

**Energy management systems (EnMSs) have emerged over the last two decades as a proven best practice methodology to ensure proactive and effective energy management. EnMSs offer a structured and systematic approach for integrating energy efficiency into an enterprise management culture and daily practices, through the provision of:**

- **A framework for understanding energy use and consumption.**
- **Action plans to continually improve energy performance, including energy systems and production processes.**
- **Metrics to track and quantify energy performance against a baseline of energy consumption.**
- **Data and documentation to sustain and demonstrate energy performance improvements over time.**

EnMSs seek to apply to energy use and consumption the same culture of continual improvement that has been successfully used by industrial firms to improve quality, environment and safety practices.

An evaluation of the impact of national industrial energy efficiency programmes based on the adoption and implementation of EnMS standards in Denmark, Ireland, the Netherlands and Sweden showed that the annual energy performance improvement rate of industrial enterprises that implemented EnMSs was more than double that of enterprises without EnMSs. Moreover, experiences in Europe and the United States, as well as early pilot implementation of ISO 50001 showed that in companies that were totally new to energy management, average energy performance gains in the first one to two years ranged between 10 and 20 per cent of baseline consumption.

## ISO 50001:2011 – Energy management systems – Requirements with guidance for use

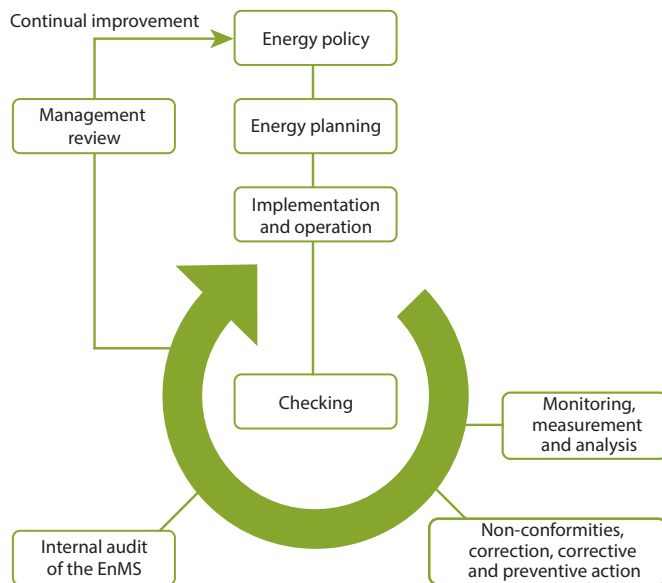
Taking stock of the good results achieved through national EnMS standards in various countries, UNIDO started to promote the development of an international EnMS standard in 2006. In UNIDO's view, an internationally recognized standard would be particularly helpful to developing countries and economies in transition that still lack policy frameworks and mechanisms to promote and achieve improved energy efficiency in the industrial sector.

UNIDO initiated the process that subsequently led to the publication on 15 June 2011 of the international standard ISO 50001:2011, *Energy management systems – Requirements with guidance for use*.

ISO 50001:2011 offers a framework for organizations to:

- Establish an energy policy;
- Allocate resources and create teams to effectively implement an energy management system;
- Conduct energy reviews;
- Identify opportunities for improving energy performance;
- Establish baselines and energy performance indicators for tracking progress;
- Set energy performance improvement targets; and
- Implement action plans to achieve those targets.

Figure 1. EnMS model for ISO 50001

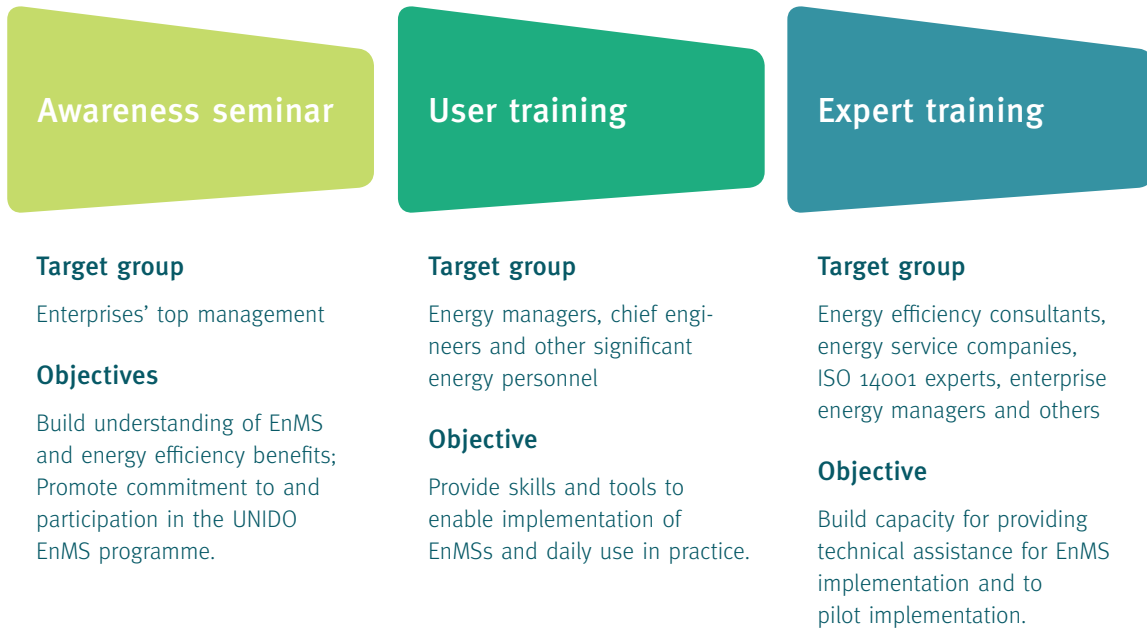


Central elements of the standard include attention to energy performance in operations, procurement and design, as well as an internal audit process to determine how well the organization is doing in implementing the system and achieving its targets.

# The UNIDO programme on energy management system implementation in industry

The UNIDO programme on EnMS implementation in industry combines capacity-building and pilot implementation. It builds understanding, expertise and skills of consultants and enterprises for implementing EnMSs in line with ISO 50001 and provides expert advisory services needed to ensure implementation. The UNIDO EnMS programme comprises three elements: an awareness seminar, user training and expert training.

Figure II. Elements of the UNIDO programme on EnMS implementation in industry



# Energy management system user training

The objective of this training is to provide enterprise staff with the knowledge, understanding and tools needed to initiate the development and implementation of an EnMS in line with ISO 50001.

## Learning goals of the user training

Knowledge and skills that participants attain through the user training include the following:

- A good understanding of the key elements of an EnMS aligned with ISO 50001, including policy, roles and responsibilities, energy planning, implementation and operation, performance checking, and management review;
- A good understanding of the benefits of EnMSs and ISO 50001;
- A good understanding of the resource requirements for EnMS implementation;
- The ability to put together a high-level project management plan (time, resources, etc.) to implement an EnMS within their organization; and
- The ability to initiate the development and implementation of an EnMS.

## Target participants of the user training

The user training is primarily targeted to enterprises' energy managers, engineers and other personnel responsible for energy management. The training

also lends itself as a thorough introduction to EnMS implementation for policymakers, energy efficiency professionals, management system consultants and other energy or management system practitioners.

## Content of the user training

The user training is delivered through classroom sessions over two days. It consists of PowerPoint presentations, exercises, discussions, interactive tools demonstration and a final workshop to apply and test understanding. The content of the training includes:

- Overview of an energy management system
- Project management – EnMS implementation
- Management commitment
- Energy policy
- Developing energy information and plans
- Energy metrics
- Day-to-day operations
- Checking
- Management review
- Workshop on EnMS implementation



# Energy management system expert training

The objective of the UNIDO EnMS expert training programme is to create a cadre of national energy efficiency experts equipped with the knowledge, skills and tools needed to support the implementation of energy management systems aligned with ISO 50001. By working with and providing expert assistance to enterprises, the expert training programme also leads to EnMS implementation in participating enterprises.

## Learning goals of the expert training

At the end of the expert training, national trainees possess the following set of knowledge, expertise and skills:

- Knowledge of the strategic benefits of EnMS implementation.
- A strong understanding of all elements of an EnMS that conforms to the ISO 50001 standard, as well as best practices and how to implement them.
- A sound understanding of energy performance metrics and relevant best practices.
- A strong understanding of resource requirements and costs involved in the implementation of EnMSs in industrial organizations.
- A good understanding of key barriers to EnMS implementation and possible mitigation measures.
- The ability and experience needed to implement an EnMS in an industrial facility.
- The ability and experience needed to audit an EnMS, verifying and reporting on its energy performance.
- The ability to deliver seminars and training on EnMSs and ISO 50001.
- Knowledge of legislation and regulations relevant to the implementation of EnMSs in a specific country.
- Knowledge of financing options available for EnMS implementation and energy efficiency (EE) projects in a specific country.

## Target participants of the expert training

The expert training is primarily targeted to energy and energy efficiency professionals, as well as energy managers from industrial enterprises. Management system experts (i.e. ISO 9001 or ISO 14001) with sufficient energy knowledge may also attend the training. Trainees are selected on the basis of specific criteria and interviews.

## Structure and approach of the expert training

The expert training consists of three modules and an exam:

**Module 1 – EnMS planning and energy performance**

**Module 2 – EnMS implementation and operation**

**Module 3 – EnMS checking and management review**

### Qualification exam

The modules are delivered mainly through classroom sessions. Modules are separated by periods of time ranging from three to six months, during which trainees work with partner enterprises under

the supervision and coaching of international experts to apply the knowledge, skills and tools provided in the classroom sessions on the job.

It is worth mentioning that all expert trainees are required to attend the user training first.

In order to increase absorption, retention and use of the knowledge transferred to trainees while delivering immediate tangible results, the approach of the UNIDO programme provides for the active involvement of partner enterprises in the expert training. Such partner enterprises commit to work with expert trainees towards the implementation of an EnMS and energy efficiency measures that meet set financial criteria. They may or may not have a representative in the expert training classroom sessions. Figure III below shows a schematic of the expert training approach; figure IV shows its structure.

Figure III. The UNIDO EnMS expert training approach

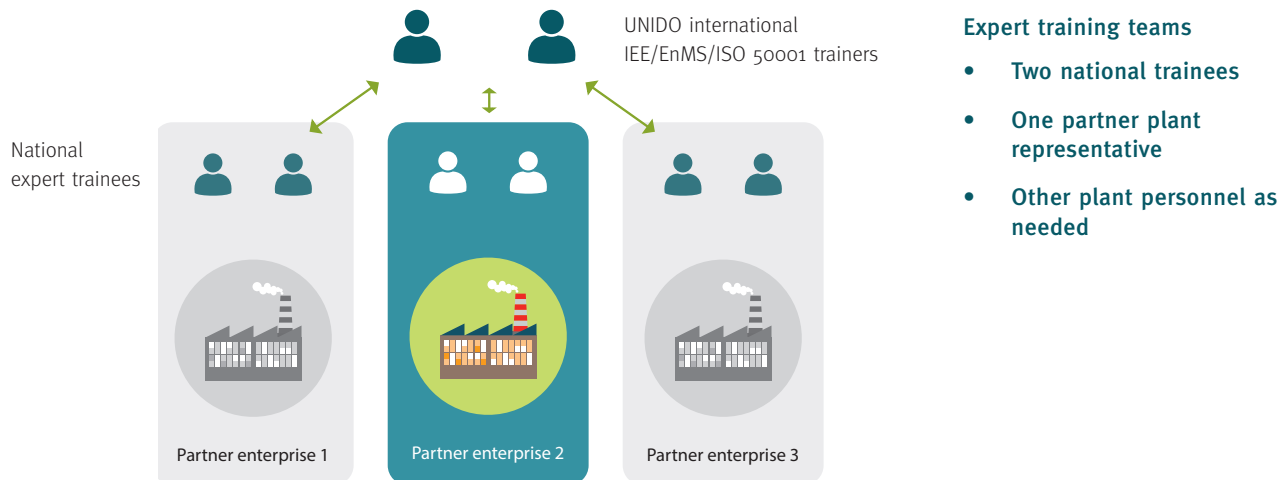
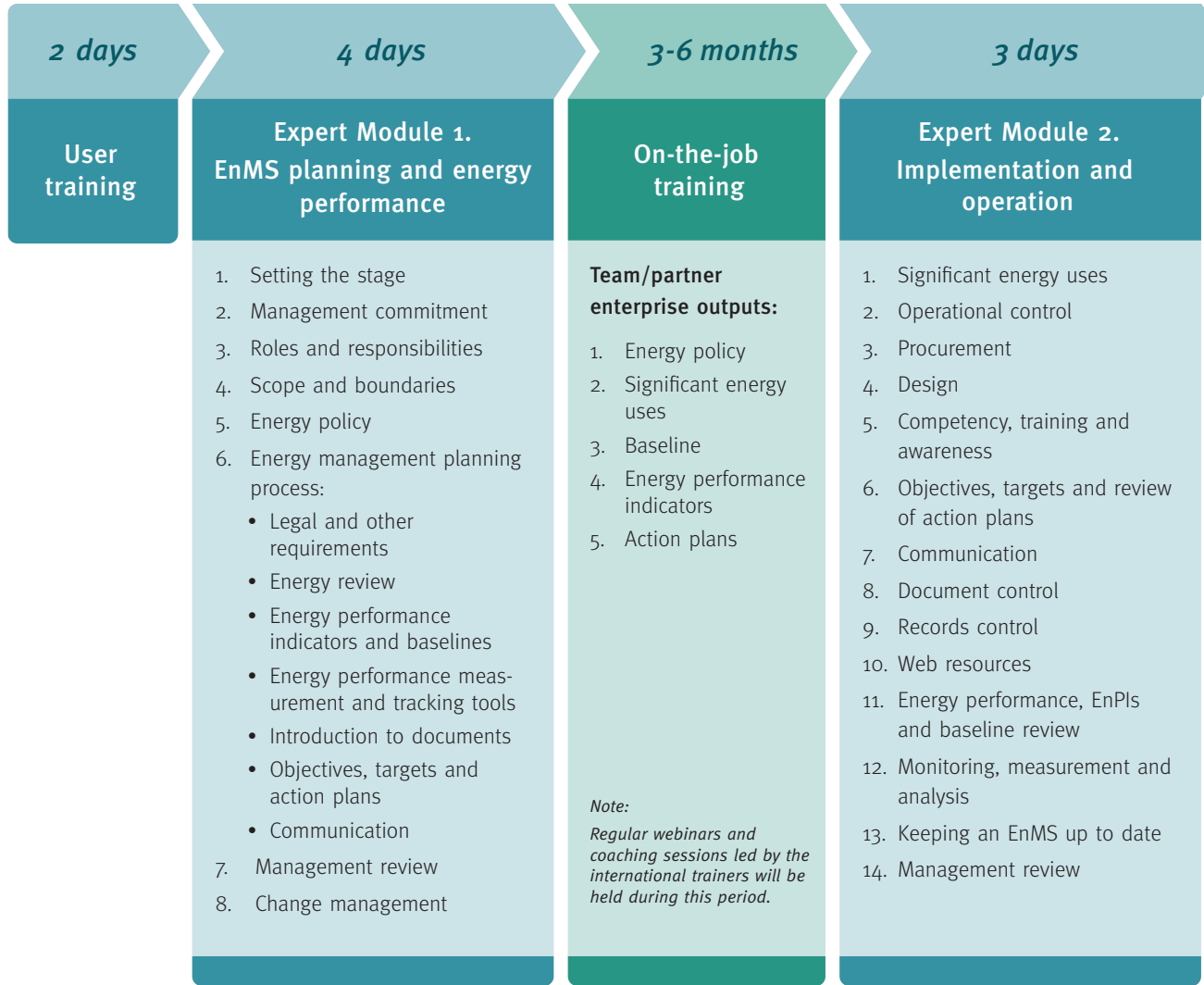


Figure IV. Structure of the UNIDO EnMS expert training programme





3-6 months

### On-the-job training

#### Team/partner enterprise outputs:

6. Training delivered and attended
7. Operations and controls improved
8. Energy efficiency projects/measures implemented
9. Energy and cost savings

*Note:*  
Regular webinars and coaching sessions led by the international trainers will be held during this period.

3 days

### Expert Module 3. Checking and review

1. Planning an EnMS audit
2. Conducting an audit and follow-up:
  - Audit preparation
  - Audit practice
  - Audit debriefing
3. Non-conformance, correction, corrective and preventive action
4. Reviewing and sustaining the system

2-3 months

### On-the-job training

#### Team/partner enterprise outputs:

10. Energy performance checked, verified and reported
11. Energy performance reviewed by top management
12. Decisions for next period

*Note:*  
Regular webinars and coaching sessions led by the international trainers will be held during this period.

### Experts exam

#### Evaluation criteria

- Competence and understanding demonstrated during classroom sessions
- Performance and quality of deliverables produced while working with partner enterprises
- Score on examination

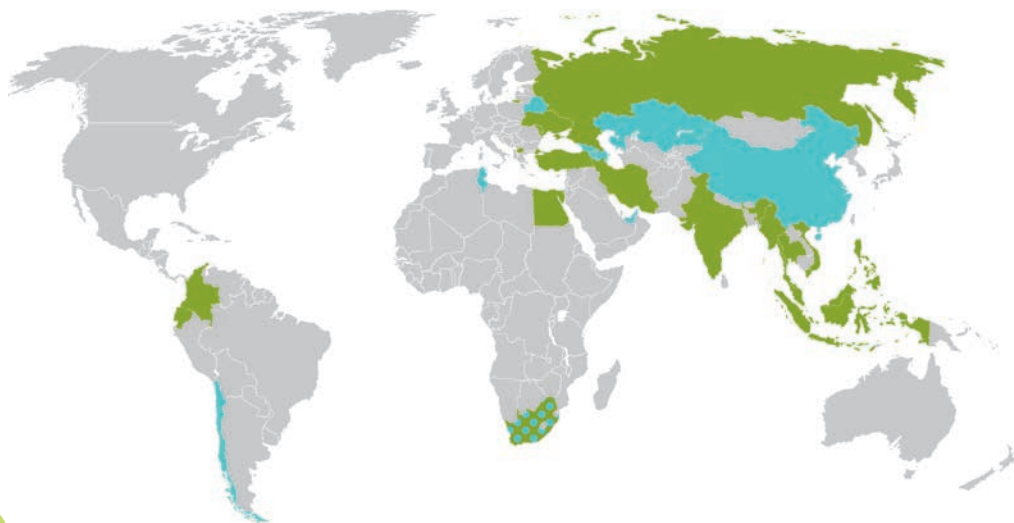
## Overview of the UNIDO global energy management system programme

As of January 2015, the UNIDO global EnMS programme is active in 17 developing countries and emerging economies.

It is the flagship initiative of the broader UNIDO Industrial Energy Efficiency (IEE) programme, which consists of around 35 technical cooperation projects with a total portfolio budget of US\$ 105 million and committed co-financing from government partners, industry and financing institutions of more than US\$ 660 million. UNIDO has provided in-depth training on EnMS implementation to more than 800 national energy efficiency consultants through its global EnMS programme. Moreover, 300 companies have

been assisted in the implementation of energy management systems and state-of-the-art energy efficiency optimization projects and practices. The current global EnMS portfolio is highlighted in figure V below, with indication of ongoing discussions on expanding activities to more countries in the period 2016-2017. It is worth mentioning that all UNIDO EnMS country projects also include a policy development component wherein UNIDO supports national governments in strengthening the institutional capacity for industrial energy efficiency, policies and programmes. Accordingly, UNIDO provides technical assistance for establishing IEE frameworks, which in turn promote and accelerate the adoption of EnMSs and ISO 50001 in industry.

Figure V. Overview of UNIDO's current global EnMS portfolio



### Active UNIDO EnMS programmes

Colombia	Republic of
Ecuador	Moldova
Egypt	Russian Federation
India	South Africa
Indonesia	Thailand
Iran (Islamic	The former Yugoslav
Republic of)	Republic of
Malaysia	Macedonia
Myanmar	Turkey
Philippines	Ukraine
	Viet Nam

### Planned activities

Armenia	Kazakhstan
Azerbaijan	South Africa
Belarus	Tunisia
Chile	United Arab
China	Emirates
Georgia	

## Case Study 1. ArcelorMittal Saldanha Works Plant, South Africa

ArcelorMittal Saldanha Works Plant (AMSW) produces hot-rolled coil steel products. The management team was faced with the challenge of improving competitiveness in a short period of time due to the global and national economic downturn in 2008, which affected AMSW's energy costs and productivity to a greater extent than that of its international competitors. On the one hand, energy prices in South Africa had increased significantly in 2008; on the other, the quality of iron ore had been depleting, leading to an increased need for energy to process steel. Threatened with the risk of closure, the plant had to find a means to limit the impact of growing energy prices on its production costs with minimal investments and in a timely fashion.

AMSW chose to participate in the UNIDO EnMS Programme in South Africa in 2009. Following the first EnMS training of AMSW plant managers and engineers in early 2010, a female Energy Manager was appointed to develop and implement an energy strategy for the plant. The strategy provided the framework for the subsequent development of an AMSW energy policy and the conducting of an energy audit to identify improvement opportunities for significant energy uses. The strong commitment exhibited by top management and leadership of the Energy Manager proved critical in driving the process of significant organizational and behavioural change that resulted in a remarkable US\$ 9 million in energy cost savings in the first year of EnMS implementation. The direct contribution of

### ArcelorMittal Saldanha Works Plant Energy efficiency achievements, 2011-2012

Total number of EnMS measures	12
Total investment (US\$)	50,000
Gross financial savings for 2011 (US\$)	9,000,000
Overall payback period (in years)	0.01
Energy savings for 2011 (GWh)	80
GHG emission reduction (tons CO <sub>2</sub> )	77,222

employees at various levels of hierarchy within the plant was encouraged through the designation of three “energy champions”, who joined the Energy Manager to form the AMSW Energy Management Team. The team served the dual purpose of opening communication channels between different production areas and organizational units, thereby facilitating dialogue on innovative means to reduce the plant's energy consumption, while simultaneously ensuring increased awareness through all ranks with continual training on the EnMS (e.g. through process-wide operation control optimization). The EnMS led to substantial energy cost reductions at AMSW and prevented the closure of the plant in its first year of implementation, while leading to slightly greater energy cost savings during the second year, demonstrating a continuous process and culture for energy performance improvement at AMSW.

## Case Study 2. S.A. Lactis, Moldova

S.A. Lactis is an open joint-stock company with approximately 185 employees that processes milk and produces fresh dairy products under the company's own trademark, "Lactis". It holds approximately 10 per cent of the Moldovan dairy market. In 2009, Lactis' management started to look into energy efficiency as a viable means to reduce production costs and the impact of increasing energy prices. The focus was on identifying "low hanging fruits" to achieve immediate energy and cost savings with minimal investments.

### S.A. Lactis achievements through the implementation of an EnMS, 2011-2012

Total number of projects	11
Total investment (US\$)	6,900
Gross financial savings (US\$)	22,000
Overall payback period (in years)	0.32
Energy savings for 2011 (MWh)	328
GHG emission reduction (tons CO <sub>2</sub> )	160

Since joining the UNIDO EnMS Programme in Moldova in September 2011, S.A. Lactis has experienced notable and sustained improvements in its energy efficiency. During the first year of implementation, the enterprise achieved an annual reduction in electricity and natural gas consumption of 4 per cent and 22 per cent, respectively, while maintaining the same production level.

These rapid improvements, achieved at no cost or low cost, were made possible through a number of energy management measures. For example, the optimization of milk processing schedules and the installation of 11 second-hand meters enabled better tracking of significant energy uses against different consumption drivers, providing information to production managers on a daily basis and allowing unexpectedly high consumption patterns to be acted upon and rectified immediately. Enhancing the capacity of staff through training to identify and intervene on high levels of energy use led to a number of proposals for improvement from employees, such as the shutting off of one boiler that was found to be unnecessary following the rescheduling of production and adjustment of water heating and cooling systems.

In short, EnMS implementation triggered and enforced a culture of improved operational control on the production floor, along with greater data diligence and accuracy of energy performance indicators, all at little to no cost. S.A. Lactis' management demonstrated their satisfaction with UNIDO's skills-based approach by opting to participate in the UNIDO Steam System Optimization Programme as well, committing to invest approximately US\$ 410,000 in further energy efficiency measures and deciding to replicate EnMS implementation in a new dairy factory acquired in 2014. The EnMS has been adopted as a continual process of improving overall performance and competitiveness at S.A. Lactis and is delivering real benefits to the enterprise as a result.

### Case Study 3. Sidi Kerir Petrochemicals Company (SIDPEC), Egypt

SIDPEC is an Egyptian petrochemical company based in Alexandria. With about 1,000 employees, SIDPEC runs continuous operations for the production of ethylene, polyethylene, LPG and butane-1 for both domestic and international markets (50 per cent-50 per cent). SIDPEC had realized clear energy benefits through previous management systems, including ISO 14001 and ISO 9001, as well as tools for process improvement such as Lean Six Sigma, when the Egyptian energy situation started to be put under pressure. Strong and systemic commitment to improving energy performance became a priority for top management amidst rising energy costs and insecurity of supply.

SIDPEC joined the UNIDO EnMS Programme in Egypt at the end of 2013, and assigned the following long-term objectives to be achieved by the end of 2018: reduce electrical consumption by 10 per cent; reduce imported fuel gas consumption by 10 per cent; train 80 per cent of personnel on energy awareness. The firm and sustained commitment of top management was critical for the successful implementation of the EnMS, as was the clear definition of roles and responsibilities of the energy team formulated in January 2014. The added value of the UNIDO training was the understanding and skills attained by members of the energy team, which facilitated awareness-raising and training of energy-relevant employees at all levels in the factory. The identification of energy performance improvement opportunities by various production teams was made possible as a result of the inclusive approach, which allowed for the capitalization of varied experiences and expertise. All in all,

#### SIDPEC achievements through the implementation of an EnMS in 2014

Total number of projects	6+
Total investment (US\$)	367,000
Gross financial savings (US\$)	1,171,000
Overall payback period (in years)	0.3
Energy savings in 2014 (MWh)	40,000
GHG emission reduction (tons CO <sub>2</sub> )	53,000

gross financial savings in the first year of EnMS implementation amounted to 8.3 million Egyptian Pounds. Upon certification to the ISO 50001 standard in December 2014, benefits accrued by SIDPEC through EnMS implementation had gone beyond energy and cost savings. Indeed, SIDEC staff reported increased cohesion as a result of cross-functional team building for the EnMS, which eliminated barriers between various production plants. Production areas with a surplus of utilities were identified and paired with other areas that had a deficit, thereby avoiding the production of more utilities. No-cost and low-cost measures have proven to have substantial energy and cost savings potential in SIDPEC and to be a strong tool for convincing all company staff of the benefits of having a systemic approach to energy management and continuous improvement. As a result, energy efficiency has been integrated as part of SIDPEC's company culture and day-to-day operations.



## Case Study 4. Colusa Miliket Foodstuff, Viet Nam

Colusa Miliket Foodstuff is a joint-stock company producing a range of processed foods out of wheat powder and rice grains in Ho Chi Minh City, Viet Nam. The company places a strong focus on remaining competitive through the adherence to standards and systems approaches to efficiency. Given the success of implementing the quality management system standard (ISO 9001:2008) and the environmental management system standard (ISO 14001:2004) in 2012, the company's management felt the natural progression was to implement the international energy management system standard (ISO 50001:2011) and decided to join the UNIDO EnMS Programme in Viet Nam.

Following their participation in the UNIDO EnMS capacitybuilding programme, the company became the first business in Ho Chi Minh City to attain ISO 50001 certification. When asked about the reasons for implementing an EnMS, the company's management responded, "It is through cost reductions such as this that our future and the future of all our employees remain secure." The strong commitment of high-level management ensured the adoption of a solid EnMS structure for continuous improvement of energy performance at the Colusa Miliket company: energy savings in the first year of EnMS implementation reached 12 per cent of 2011 baseline consumption (normalized with production for 2012), and an additional 12 per cent improvement was achieved in the first three months of 2013 alone.

### Colusa Miliket Foodstuff achievements through the implementation of an EnMS in 2012

Total number of projects	5
Gross financial savings (US\$)	46,805
Overall payback period (in years)	<1
Energy savings compared to 2011 (%)	12
GHG emission reduction (tons CO <sub>2</sub> )	1,700

## Case Study 5. INDIMA S.A., Ecuador

INDIMA S.A. is a company with 146 employees that produces automotive parts in Quito, Ecuador. A supplier to multinational automotive firms such as General Motors, Kia and Great Wall, INDIMA S.A. already had experience implementing standards and management systems required by vehicle manufacturers when its management decided to commit to a formalized industrial energy efficiency initiative in 2012. This provided an opportunity for the extension of existing management structures to accommodate energy policies, procedures, sustainability teams and reporting. It was therefore possible to integrate an EnMS into existing processes in the plant in order to meet customer demand more effectively and profitably.

An EnMS was systematically planned at INDIMA S.A., beginning with the formation of teams and identification of scopes and limits of the system that would define the relevant energy policy for each sector. The support of senior management was fundamental at that stage, as it ensured the prioritization of energy efficiency in the decision-making structure and led to the creation of an energy management team. The energy team conducted a baseline survey to identify significant energy uses that would become the focus of energy management activities. The survey found the soldering, lighting and computer systems to be the largest energy consumers in the plant, and established relevant energy performance indicators to allow for their continuous monitoring. Daily monitoring of the performance of significant energy uses enabled ongoing analysis and evaluation, thereby allowing staff to promptly act to address or mitigate excessive consumption or other occurrences on a daily basis—a critical element of an effective and therefore sustainable EnMS.

Sensors and timers were particularly useful in achieving energy savings in the plant's soldering and lighting systems with minimal investment. Moreover, the energy performance monitoring system created a mindset for energy efficiency within the plant, which encouraged staff (particularly technical staff in continuous contact with the production processes) to consider and look for further methods of improvement, leading to more preventive maintenance of electric motors and mechanical drives, for example.

### INDIMA S.A. achievements through the implementation of an EnMS in 2014

Total number of projects	3+
Total investment (US\$)	66,500
Gross financial savings (US\$)	82,213
Overall payback period (in years)	0.8
Energy savings for 2014 (MWh)	394
GHG emission reduction (tons CO <sub>2</sub> )	TBD

The substantial energy savings achieved as a result of the EnMS were essential to maintaining the competitiveness of the plant, as energy prices increased considerably during the time period of EnMS implementation (by 7 US cents per kWh). The EnMS implementation protected the plant from volatile energy prices at the time, while achieving additional non-energy cost savings. This reaffirmed the top management's commitment to supporting the ongoing EnMS as an integral part of INDIMA S.A.'s day-to-day business operations.

# UNIDO capacity-building and implementation programmes for energy system optimization

The energy management system programme is only one of a series of capacity-building and implementation programmes for energy efficiency in industry developed by UNIDO. In addition to the EnMS programme, UNIDO offers training programmes for the following technical areas:

- Motor system optimization
- Pump system optimization
- Fan system optimization
- Compressed air system optimization
- Steam system optimization

The UNIDO energy system optimization (ESO) programmes build technical capacity at three levels in each of these technical areas through user, vendor and expert training.

## ESO User training

The user training is targeted at facility engineers, operators and maintenance staff of enterprises, equipment vendors and service providers. It is designed to teach how to assess systems, identify potential improvement opportunities and achieve cost savings through proper operation and controls, system maintenance, and appropriate uses of the provided energy service.

## ESO Vendor training

The vendor training is targeted at local system equipment vendors, suppliers and manufacturers. The purpose of this workshop is to introduce key market players to the system optimization approach and relevant service offerings.

## ESO Expert training

The expert training is an intensive training programme delivered by leading international system optimization experts to national energy efficiency consultants, service providers, equipment vendors and industry engineers. This training programme provides more in-depth technical information on troubleshooting and making improvements to industrial energy systems. It also introduces basic principles for energy-efficient system design and strategies for successfully selling system improvement projects to management.



