

**ENERGY
METRICS
AND
PERFORMANCE
INDICATORS**

BROCHURE



**INDUSTRIAL
ENERGY
ACCELERATOR**



Energy performance measurement, indicators and benchmarking

Energy Efficiency Solutions Series



Introduction

Did your organization meet its annual energy efficiency or CO₂ targets? Have you been able to track continuous energy efficiency improvements? If your answer is no then perhaps it's time to reconsider how you are measuring your energy savings and performance. Effective Energy Performance Indicators (EnPIs) make it possible to carefully monitor energy performance on a continuous basis, allowing your organization to identify new ways to optimize and reap the rewards of energy efficiency over time.

In 2011 the International Standards Organization (ISO) formally introduced and defined EnPIs as a **quantitative index of energy performance** which can be applied to compare an organization's energy performance at different times. Since then, awareness about the importance of accurately measuring and assessing energy performance and the impacts of various variables has slowly begun to gain ground. In 2018 ISO 50001 revised its guidelines with a stronger focus on EnPIs in an effort to normalize effective energy measurement.

Nevertheless, there is still a way to go before consistent EnPI practices are applied throughout the industrial sector. While some organizations are making efforts to measure and monitor their energy savings, many still do so in suboptimal or misleading ways. Reasons for this range from simplistic or inaccurate methods of measuring and interpreting energy consumption data, to organizational resistance to change. However, getting industrial EnPIs right across the board offers huge potential not just in terms of boosting industrial energy and cost savings, but also for society and the planet as well.

There is no shortage of resources available for industrial managers looking to make their company more energy efficient. In fact, there is so much information it can often be difficult to know where to start or what is worth researching further. This knowledge kit provides an overview for leadership teams on what effective energy performance monitoring is and how paying attention to it can bring added value to industrial organizations. In this kit you will find insights from global experts as well as external links to recommended references, manuals and technical guides. The introductory video, case studies and this brochure are great starting points for generating awareness about the benefits and opportunities that come from enhancing energy measurement and performance indicators in your organization.

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Without energy performance indicators, it's like navigating in the dark, you just don't know where you're going. You might have implemented the energy efficiency measure, but how can you be sure it actually works?"



Lukas Eggler, Austrian Energy Agency

What are energy performance indicators?

Energy metrics and energy performance indicators provide organizations with the insight required to continuously gauge the effectiveness of their energy management efforts.

EnPIs enable industrial organizations to compare the energy performance of their site to that of an earlier period, which is typically called a reference period or a baseline. If an organization wants to improve its energy performance, it must be able to measure and assess its energy performance accurately according to predetermined baseline data. From that point, informed decisions can be made about how to improve energy performance, factoring in a variety of variables such as productivity fluctuations, equipment lifespan and weather patterns.

EnPIs are used for a variety of reasons

- To get a realistic and objective estimate of your site's energy performance.
- To make informed decisions about resources, process management and investment.
- To assess if internal and external sustainability goals and commitments have been met.
- To demonstrate energy performance improvements per the requirements of an energy management system standard, such as ISO 50001.
- To detect unexpected deviations, promote reaction against them and avoid energy waste.
- To detect saving opportunities through investigating periods that show better energy performance than average.
- To determine cost savings, the rate of energy consultant repayments and/or the economic value of a particular energy efficiency project or investment.
- To establish industry, regional or national benchmarks.
- To pitch or rally for additional investment into new energy efficiency projects.



Not all EnPIs are created equal

A variety of methods can be employed to determine EnPIs. These methods include:

- **Theoretical estimates and assumptions of energy performance** by observing a range of energy performance levels.
- **Simple absolute energy consumption (no variables considered).**
- **Simple specific energy consumption (one variable considered).**
- **Regression analysis** which adjusts or 'normalises' energy performance by considering and/or removing influential variables.
- **Sophisticated technical modelling**, which requires specific modelling software.

UNIDO's recommended approach uses actual levels of energy performance data is analysed through regression analysis to adjust for relevant variables. This statistical process is used to estimate the relationships between a dependent variable (i.e. energy consumed) and one or more independent variables such as production volumes or weather patterns which can directly impact the amount of energy consumed during a specific period.

Regression-based indicators are critical for enterprises that truly want to improve energy efficiency and performance, and also sustain top management, middle-management and whole enterprise staff commitment to energy management over time.

This statistical process is used to estimate the relationships between a dependent variable and one or more independent variables such as production volumes, productivity or weather patterns which can directly affect the amount of energy consumed within an industrial facility.

Sound EnPIs complete the EE business case

Enterprise decision makers expect to see clear results and return on their investment into energy efficiency. Inaccurate or overly simplified performance indicators are among the main deterrents for long-term investment into energy saving measures as they don't always paint a clear or compelling value proposition. That's why being able to show informed performance improvement is essential for mobilizing ongoing investments into energy efficiency.

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There is no need to be afraid of statistics. You do not need to be a mathematician or a rocket scientist to develop appropriate energy performance indicators. You just need to collect data and use some basic excel tools to start monitoring performance adequately.”



Luis Marques, Energy performance specialist and UNIDO trainer

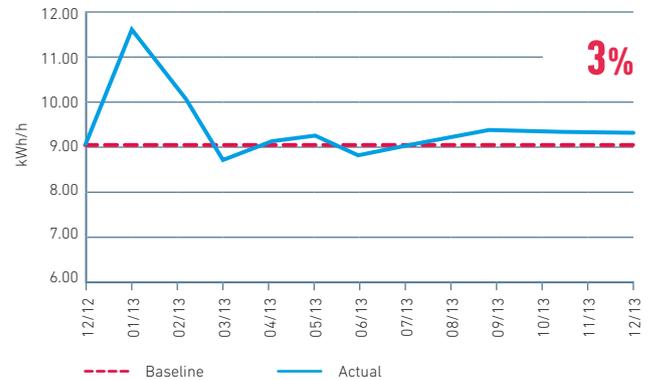
CASE STUDY

The three figures below, based on the results of a real UNIDO case study in the brewery industry, depict the wildly different energy performance conclusions can be drawn in the same time period depending on which method is used to determine the baseline and EnPIs. It's for this reason that UNIDO strongly advocates for the use of regression based indicators when developing EnPIs.

Absolute consumption



Ratio kWk/hl



Regression based indicators



ADDITIONAL RESOURCES

ECEEE

READ

The value of regression models in determining industrial energy savings

ISO 50006

READ

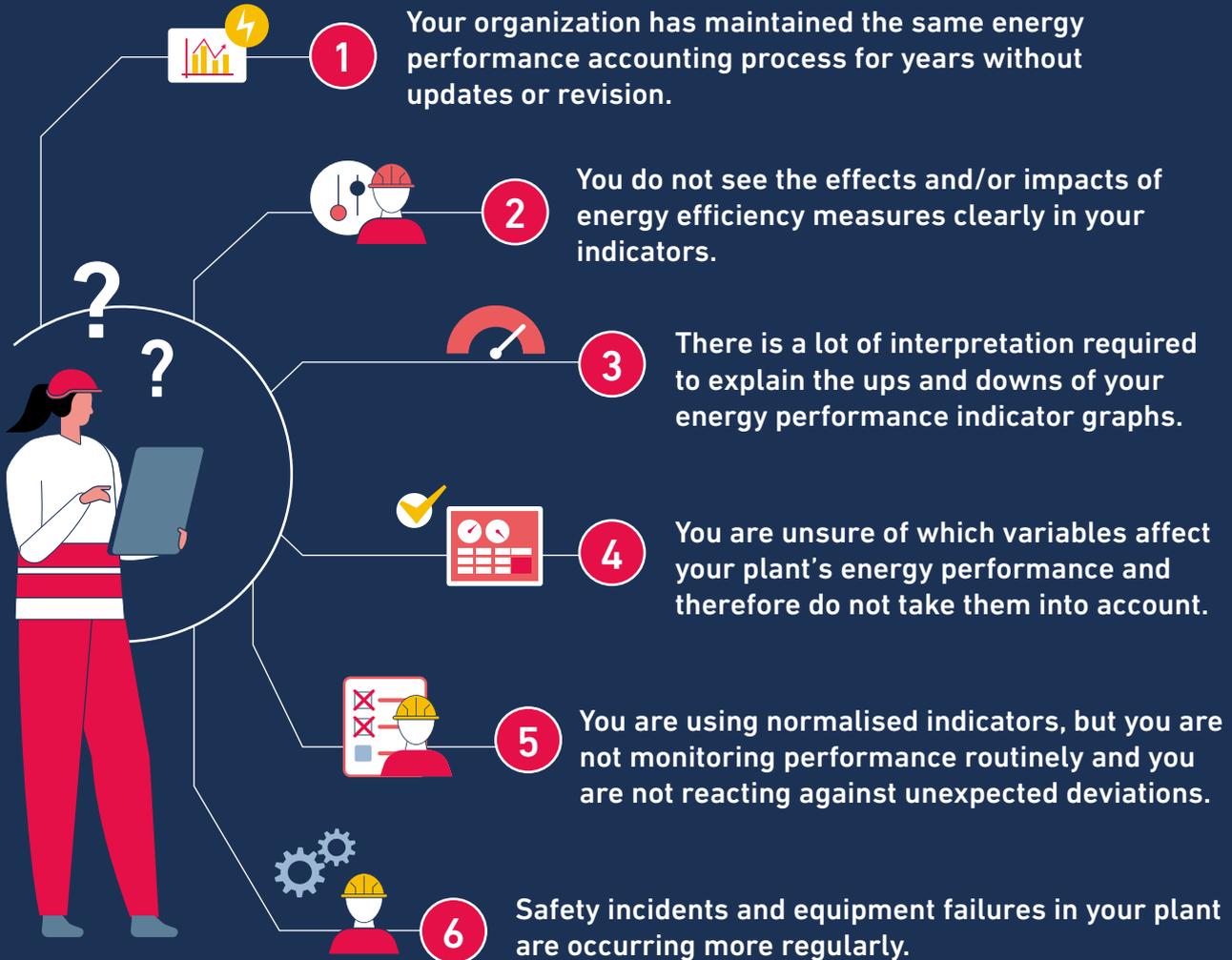
2014 Energy management systems — Measuring energy performance using energy baselines (EnB) and energy performance indicators (EnPI) — General principles and guidance

ISO 50015

READ

Energy management systems — Measurement and verification of Organizational Energy Performance - General Principles and Guidance

Six signs you need to improve your EnPI approach



What are the benefits of improved EnPIs?

Getting EnPIs right can transform the potential energy savings available to a particular organization. Using carefully considered and measured EnPIs is like shining a flashlight in a dark attic which can uncover some unexpected treasures. In UNIDO's experience, most organizations that incorporate regression analysis into their EnPI approach achieve additional energy savings. Even if industrial organizations have been implementing an energy management system for a long period of time there are always more opportunities to improve, especially with more advanced EnPIs.

Other benefits of improved EnPIs include

- A more detailed understanding of your energy system enabling identification of new saving opportunities.
- More consistent data can be relied upon for more accurate business and investment decisions.
- Ability to confidently forecast energy demand, allowing for better resource planning and more cost-effective procurement of energy.
- Ability to react much faster to deviations from expected or targeted consumption rates and then mitigate problems causing excessive consumption as a result.
- Predictive maintenance and management which enables faster responses to safety and maintenance hazards before they become major problems.
- Empowerment of companies to take data collection and management back into their control, thereby reducing the need to hire external consultants.
- Readiness for ISO 50001 certification which requires continuous improvement and for organizations to normalise EnPIs through regression analysis.
- Strengthening of the local energy services company (ESCO), given many ESCO businesses rely on accurate reporting, monitoring and measurement for payment.
- Ability to accurately measure, monitor, mitigate and communicate non-energy benefits as well as the organization's impact on the environment and local community.



ADDITIONAL RESOURCES

ARTICLE

The True Value of Your Energy Savings is More Than You Think

REPORT

IEA, Capturing the Multiple Benefits of Energy Efficiency

Benchmarking industrial energy performance

Unlike energy performance indicators, which compare a plant or an organization's performance against itself, benchmarking is a comparison between different sites inside the same industry and/or sector.

For example **Canada's Office of Energy Efficiency** benchmarked the energy use of various national industries including ammonia, cement, fertiliser, food and beverage, mining, oil sands, petroleum products, pulp and paper, steel, textiles, and transportation manufacturing facilities. **In the Netherlands**, benchmarking encourages industrial companies to compare themselves to their peers and to commit to becoming among the top 10 per cent most energy-efficient plants in the world. **In the United States**, **ENERGY STAR** provides Energy Performance Indicators and excel based tools to help industrial companies benchmark industrial plant energy performance. Lawrence Berkeley National Laboratory, also in the United States, developed **BEST, 'Benchmarking and Energy Saving Tool,'** for industry to benchmark a plant's energy intensity against international best practice.

Over the years UNIDO has provided a series of benchmarks for industrial organizations in low to middle income countries want to compare their energy performance to competitors in upper-income countries.

Limitations

While benchmarking provides a useful goalpost for industry and policymakers, the practice is significantly complicated by the array of variables and methods used to determine and assess EnPIs, as well as company confidentiality and data sensitivity. It is therefore important to be mindful of these limitations especially when it comes to setting industry wide standards and policy making.



ADDITIONAL RESOURCES

UNIDO

READ

- Global industrial energy efficiency benchmarking policy tool
- Policies and measures to realize industrial energy efficiency and mitigate climate change

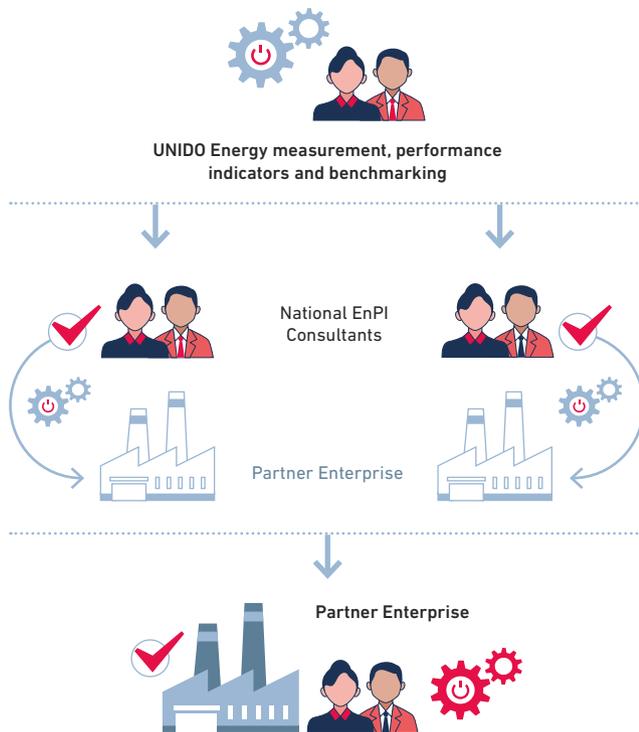
CASE STUDY UNIDO

READ

Energy Performance and Monitoring - JLC Milk Processing, Moldova

UNIDO's approach

Given UNIDO's unparalleled global reach and experience implementing industrial energy efficiency projects, the organization is uniquely placed to collate and provide the data needed to establish meaningful energy performance benchmarks for industrial organizations worldwide. However, to do that, it is critical for industrial facilities to conduct their energy measurement and performance analysis accurately and consistently. This is why UNIDO is also working to improve awareness around EnPI best practice and methodologies.



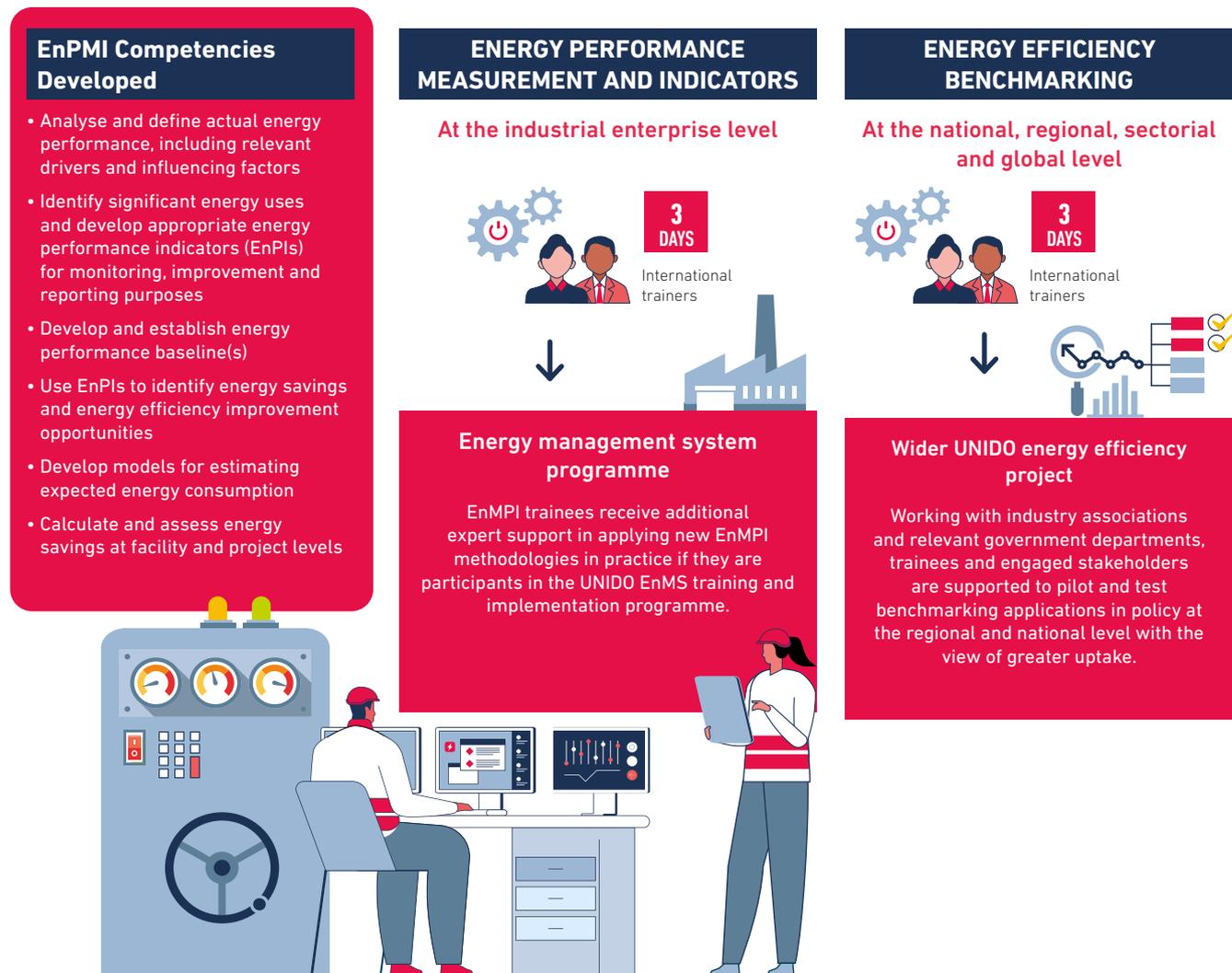
Over the years UNIDO has played a critical role as an international convener and data collector for international benchmarks and standard setting, particularly for the purposes of national and regional policymaking.

Results

Through its hands-on energy management system (EnMS) training and energy system optimization training programmes, in addition to dedicated EnPI and benchmarking short courses, UNIDO's Energy Programme has exposed thousands of energy managers and industry practitioners to energy performance measurement best practice, saving millions of tons of carbon emissions in the process.

UNIDO's specialised energy performance metrics, indicators and benchmarking training

With support from international trainers and the commitment of partner enterprises, participants are taken through a series of modules that ultimately help them to carry out meaningful and accurate assessments, measurements, monitoring and reporting of energy performance, including defining robust baselines which are critical for the effective implementation of energy management systems such as ISO 50001.



Your Energy Metrics and Performance Indicator Questions Answered

UNIDO has steadily grown its cohort of international and national energy and non-energy performance management experts over the past decade. With experience in many of the world's major industrial countries and regions, our team of specialised consultants have a long track record of leading organizational teams to achieve impressive results. In this kit you will find a video featuring two of our experts who answer common questions about energy measurement, performance indicators and benchmarking.



Luis Marqués

Luis Marqués has worked in the field of sustainability, energy management systems and energy performance indicators for 15 years. Since 2012, Luis has been the Energy Performance Director at GEN Europe (www.geneu.eu). His experience spans a vast array of sectors from the pharmaceutical and chemical industry, cement, oil refineries and petrochemicals, food and beverage to electronics, data centres, universities, real estate and defence among other fields. In 2014, Luis joined UNIDO as an international expert on energy performance indicators. He is the co-author of the two-day training programme on energy performance indicators for energy management systems and advanced energy metrics. To date Luis has supported a number of UNIDO projects in Russia, Moldova, North Macedonia, Iran, Georgia and Austria.



Lukas Egglér

Lukas Egglér has worked in the field of renewable energy and energy efficiency since 2012. He is currently the key expert for consulting private companies on the topic of statistical energy models and advanced energy performance indicators at the Austrian Energy Agency (AEA, www.energyagency.at). He is also the head trainer of the AEA Academy training course on advanced energy indicators, an initiative that works to promote the advantages of model based indicators in the energy management world. Lukas has been involved in numerous large scale, multi-site industrial EnPI projects throughout Austria including work with Siemens, the largest industrial manufacturing company in Europe.

About the Energy Efficiency Solutions Series

The Industrial Energy Accelerator is a UNIDO-led network of international initiatives working to inspire global action on industrial energy efficiency. The Accelerator is drawing on its collective wealth of experience and expertise to produce a series of knowledge kits on industrial energy efficiency. The kits cover five key Energy Efficiency Solutions: Energy Management Systems; Efficiency Solutions for Motor-driven Systems; Efficiency Solutions for Industrial Heat; Efficiency Solutions for Industrial Cooling; as well as Energy Metrics and Performance Indicators. Through this series, the Accelerator aims to inspire and equip industry practitioners to take the first step towards enhancing their energy systems.



NEXT STEPS

Visit our knowledge hub for more information on the processes and technology that will help you achieve energy efficiency in your company.

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to find out how UNIDO'S Industrial Accelerator can help you.

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