

AUDIT **2** ACTION

Saving energy in industry

A guide to implementing
measures after energy audits



AUDIT2MEASURE



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CONTENTS

- 02** Introduction
- 04** Overview of energy audits and ESM implementation in companies
- 06** Understanding the outputs of energy audits
- 07** Non-energy benefits of energy-saving measures
- 11** Implementing ESM
- 18** Finding external support to the implementation of ESM
- 20** Self-assessment and ISO 50001
- 22** The energy efficiency implementation checklist



INTRODUCTION

The implementation of Energy Saving Measures (ESM) in companies produces more than economic benefits: reduced energy consumption leads to lower emissions, and there are also the so-called Non-Energy Benefits (NEB), that include productivity and security improvements, as well as higher employment satisfaction.

The Audit2Action is a strategy designed for companies looking to implement ESM that have been recommended in energy audits. The strategy addresses informational, behavioural, organizational, and economic barriers hindering the uptake of ESM. It aims mainly at medium to high level management (e.g. heads of department and directors) but can also be useful to energy leaders at other levels (e.g. operational staff with large experience in a certain energy service) seeking innovative solutions.

Looking to make the Audit2Action strategy more actionable, this guide will support energy decision makers and managers in companies to overcome different barriers and better understand how ESM can benefit their business.

This document is based on the report “A2A strategy: a new approach to upgrade energy audits outcomes”, released by the European-funded project AUDIT2MEASURE.

Further resources on ESM implementation in industry are available at the AUDIT2MEASURE secure Knowledge Exchange Space (KES), where industry players share knowledge, experience, cases, and findings in a collaborative environment. To access the KES, visit <https://ieecp.org/projects/audit-to-measure>.

WHAT IS AN

ENERGY SAVING MEASURE

An ESM is a project, technology, or change implemented to reduce final energy consumption in a facility and can be broadly categorised into different groups:



Operational
improvements



Equipment
upgrades



Building
improvements



Renewable
energy



Behavioural
changes

OVERVIEW OF ENERGY AUDITS AND ESM IMPLEMENTATION IN COMPANIES

Energy efficiency has been present in European and National regulations for over a decade now. Since the 2007 action plan of the European Commission for a common energy policy, several targets and recommendations have been set.

2012

1st Energy Efficiency Directive (EED)

2023

Revised Energy Efficiency Directive

2018

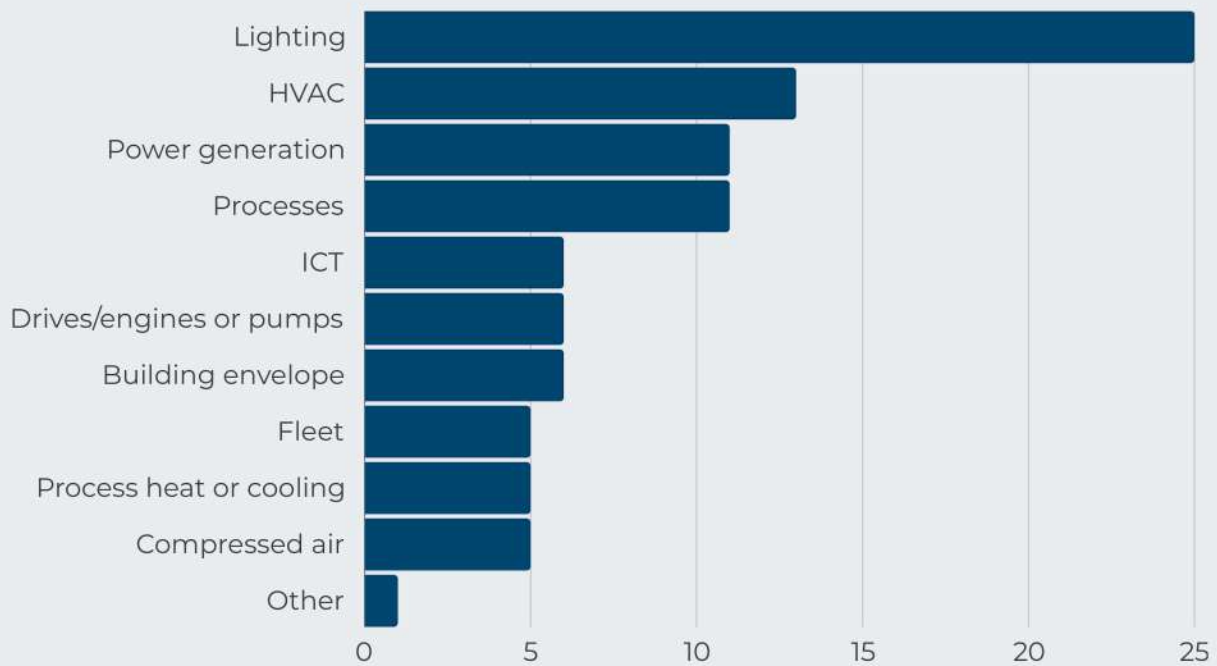
Amendment of the Energy Efficiency Directive

Timeline of EE and ESM regulations in Europe

Generally, the roadmap to higher energy efficiency in industry should be linear: a company facing high energy consumption and looking to comply with new regulations runs an energy audit and then takes on its recommendations.



However, the industrial sector still shows some remarkable implementation gaps in several ESM areas. An analysis of the current auditing system and ESM implementation in European industries, carried out by the AUDIT2MEASURE project [1],[2],[3], shows that companies don't always pursue the implementation of all measures proposed by energy auditors – often due to lack of financial resources and organisational barriers.



Most frequently implemented ESM categories (Source: AUDIT2MEASURE D2.2 report)

The Audit2Action strategy proposes to address these barriers and support industries in choosing, considering, and implementing ESM that have been recommended by recent energy audits.

[1] Report of state-of-the-art auditing system and ESM implementation, April 2023
[2] Top management decision process, June 2023
[3] Report of barriers affecting the uptake of ESM in companies, July 2023

UNDERSTANDING THE OUTPUTS OF ENERGY AUDITS

The outputs of energy audits in industrial settings can help companies reduce their energy consumption, save money on energy costs and improve their environmental sustainability.

Typically, these outputs follow a standardized approach:



Typical structure of an energy audit report.

The major differentiation point of an energy audit is the analysis of potential ESM for a specific industrial sector. By considering business and operational specificities when proposing measures, auditors may optimize the energy management plan and increase its effectiveness.

NON-ENERGY BENEFITS OF ENERGY-SAVING MEASURES

When energy experts and industrial companies discuss energy efficiency projects, focus often lies on potential energy savings. However, these projects may produce secondary effects that are just as valuable – or even more – as reducing energy consumption. Such secondary effects are typically referred to as NEB.

Due to there not being a commonly recognized method for calculating the value of NEB, they are seldom prioritized or even included in the implementation economics of energy efficiency projects. However, research suggests that the inclusion of NEB may raise the true value of energy efficiency projects up to 250% compared to the calculation of energy efficiency improvements alone.

Research shows [4] that many companies perceive the Non-Energy Benefits as cost reductions (with material, salaries, sick leaves, or noise enclosures); however, NEB can also translate into increased revenue (from improved productivity and higher production volume).

SOME NON-ENERGY BENEFITS OF ESM



Reduced carbon emissions



Reduced maintenance costs



Improved working environment



Reduced production downtime



Reduced waste

[4] "A Systematic Literature Review of Methods for Improved Utilisation of the Non-Energy Benefits of Industrial Energy Efficiency", T. Nehler, Energies, 2018

In general terms, the most common NEB of ESM in the industrial sector can be distributed into six categories: production, operation and maintenance, work environment, waste and water, emissions, and others. Even though there is no standard measuring methodology, it is possible to determine monitoring indicators for them.

The effects of implemented or potential EEM on different processes, technologies, and behaviours can be both assessed (ex-post) or estimated (ex-ante) qualitatively or quantitatively. The quantitative assessment of EEM impact on key financial indicators (such as payback time, net present value, or internal rate of return) is capable of strongly influencing the investment decision [5].

The table below gathers some examples of NEB usually found in industry and how they are measured [6].

	NEB	Indicators (examples)
Production	<ul style="list-style-type: none"> • Increased productivity • Reduced production costs • Improved product quality 	<ul style="list-style-type: none"> • More units/hour of products (unit/h) • Reduced cost per produced unit (€/unit) • Positive customer satisfaction
Operation and maintenance	<ul style="list-style-type: none"> • Reduced wear of equipment • Reduced cleaning requirements 	<ul style="list-style-type: none"> • Less operation & maintenance costs (€) • Less cleaning costs (€)
Work environment/health/safety	<ul style="list-style-type: none"> • Improved worker safety • Improved health and comfort conditions 	<ul style="list-style-type: none"> • Reduced insurance costs (€) • Improved air quality (ppm)
Waste and water	<ul style="list-style-type: none"> • Reduced waste • Greater efficiency and control of water use, reduced water use. 	<ul style="list-style-type: none"> • Less cost of waste disposal or transport (€) • Decreased cost of water use (€)

[5] Wagner, C., Obermeyer, M., & Lüchinger, R. (2020). A methodology for the assessment of multiple benefits of industrial energy efficiency measures. *SN Applied Sciences*, 2, 1-16

[6] Non-Energy Benefits of Industrial Energy Efficiency, Roles and Potentials", Therese Nehler and Linköping, Studies in Science and Technology, Sweden.

Emissions

- Reduced emissions of dust and criteria pollutants
- Less fines or no fines due emissions (€)

Others: sales, competitiveness, etc.

- Improved image in society
- Improved competitiveness
- Increased sales due to reputation, publicity (unit or €)
- Improved customer satisfaction

SHARING DATA FOR COLLECTIVE SUCCESS

The results of pilot Key Performance Indicators (KPI) assessments will be stored in the AUDIT2MEASURE database. This database will provide companies with specific, comprehensive, clear, and reliable quantitative and qualitative information on decision criteria for ESM implementation. It will also offer insights on expectations/results of ESM implemented in different industrial sectors, countries, and business contexts.

IMPLEMENTING ESM

Even though energy audits tend to provide clear recommendations, the implementation of ESM does not always go through with the expected easiness. Research shows [7] that, despite variations depending on the size and turnover of the company, complex decision-making processes, lack of time, and lack of human resources are common barriers to a smooth implementation of measures recommended by energy audits.

Albeit not solving understaffing issues, the following steps may support the decision to implement energy-saving measures in a company, both by suggesting prioritisation criteria and by presenting information in a way that it is quicker to process.

SELECTING WHICH MEASURES TO IMPLEMENT

Company surveys ran by AUDIT2MEASURE show that several factors usually weight in on the prioritisation of which energy-saving measures to implement in a business:



Most prevalent factors in the selection of ESM in companies

Such factors may, however, be too broad to support informed investment decisions, as managers often need more accurate, comparable indicators. AUDIT2MEASURE proposes, thus, a set of KPI that translate factors into measurable data. Although the list is

[7] Report of barriers affecting the uptake of ESM in companies, July 2023

not exhaustive, it allows for an initial ranking of energy efficiency measures based on their performance.

Evaluation factor	KPI
Energy saving potential	Primary energy savings (toe/year) Cost of energy savings (k€/toe/year)
Environmental impact	Carbon savings (tCO ₂ /year) Cost of carbon savings (k€/tCO ₂ /year)
Financial viability	Simple payback period
Non-energy benefits	Productivity, operation and maintenance, work environment, and other NEB

HOW TO RANK ESM BASED ON THE AUDIT2ACTION MODEL

The process starts with a ranking of the categories. Which is most important for the business at hand? Scores attributed will determine the weight of each category in the final decision.

ESM proposed by the audit will then be individually assessed in its performance for every KPI. Since each KPI is expressed in a different unit, and each measure may exhibit different behaviours in different KPIs (for example, an ESM may yield significant energy and carbon savings but may not be chosen for implementation by decision-makers due to a long payback period), it is necessary to convert the different KPI units to a common scale so that individual KPI values of a measure can be aggregated, resulting in a total score for both each assessment pillar and for the overall assessment.

To facilitate this method, each KPI value is assigned a score ranging from 0 to 100 points based on the maximum and minimum values in the sector's dataset. As previously stated, lower numbers are favoured for KPIs with negative polarity, whereas higher values are preferred for KPIs with positive polarity. For example, the ESM with

the quickest payback period in a specific industry will be awarded 100 points. In contrast, the measure with the highest cost of carbon savings in the same sector will be awarded zero points. As a result, the position of each value in the dataset is expressed as a percentage of the highest/lowest KPI value in the dataset. The percentage is multiplied by 100 to determine how many points each ESM is awarded for each KPI value, with 100 representing the highest possible score.

This process should result in a ranking of not only the most impactful ESM, but also of the measures that have the most relevant impact for a specific industrial sector.

FUNDING THE IMPLEMENTATION OF ESM

Despite many facility managers admitting that energy efficiency projects are suitable investments due to their operational and environmental impact, the (lack of) funding is arguably a critical factor for their success. More than finding the funds to pay for the implementation of ESM, it is important that companies research and compare financing options so to identify those which better fit their specific energy-saving needs and financial situation.

Energy efficiency loans

Specifically designed for energy-efficient projects. Typically have lower interest rates and longer repayment terms.

Energy performance contracts

The ESCO installs energy-efficient equipment and the facility owner pays back with the generated energy savings.

On-bill financing

Customers finance energy efficiency upgrades with their monthly utility bills.

Tax credits

Implemented by some countries for businesses that invest in ESM.

Energy efficiency incentives

Usually state-owned, reward energy savings achieved by projects.

The European Union (EU) offers several funding schemes to support the implementation of ESM in its member states. Among the most important are the European Structural and Investment Funds (ESIF) and the European Fund for Strategic Investments (EFSI); additionally, more specific financial instruments to support industrial energy efficiency will also be developed under InvestEU13 [8]. These funds are usually streamlined through national and regional authorities and institutions.

Many EU member states also have their own financing programs for energy efficiency and renewable energy projects, including in industrial settings. An example of such programs are the White Certificates – also known as Energy Efficiency Certificates or EEC –, which promote and reward energy efficiency improvements in industry and other sectors.

WHITE CERTIFICATES

are tradable certificates that represent a certain amount of energy saved by a company after implementing energy efficiency measures. When companies earn white certificates, they receive a financial reward for their effort.

White Certificate schemes are available in several EU countries, including Italy, France, and Belgium; the specific regulations of these schemes, however, may differ between countries and can change over time.

It is important to note that ESM financing options and policies often vary between EU member states, meaning their suitability to companies may also differ depending on the context. Therefore, it is recommended to consult with industrial associations, energy experts, local authorities, and financial institutions to get more precise information at local level.

[8] [Report of barriers affecting the uptake of ESM in companies, July 2023](#)

FINDING FUNDING

FOR ENERGY EFFICIENCY PROJECTS

1

Search open calls for subsidies aimed at energy efficient projects

2

Look for financial entities that focus on energy efficiency and/or renewable energy installations for companies

3

Screen financial institutions and select those that are reliable and show adequate experience

4

Choose the financing option that is best for your specific project

5

Research financing beforehand (some programmes demand that the request is submitted before ESM are implemented)

6

Check carefully all necessary documents and data

7

Carefully read the contract and its clauses before signing (e.g. cancellation clauses, interest periodic renovation)

TRAINING STAFF

The company surveys conducted by AUDIT2MEASURE show that several hierarchy levels may be involved in the implementation of ESM in industrial companies [9]. This means that capacity building on energy efficiency and renewable energy sources should target beyond the most obvious decision-makers and include not only other staff levels inside the companies, but also external stakeholders such as energy experts, industrial associations, and other intermediaries. AUDIT2MEASURE proposes a training approach that addresses three categories of stakeholders:

Managers

Training for company managers should go beyond the basic energy and technical information. Data should focus on the economics of energy saving (investment, potential savings, funding and financing possibilities), emphasizing also other multiple benefits, policy, and regulatory aspects (reduction of carbon footprint, non-financial reporting), quality and environmental aspects, and marketing (public image, PR/communication).

Skills to develop	Topics to include
<ul style="list-style-type: none">• Define a clear strategy and plan for ESM investments• Understand energy consumption of the company and consequent costs• Learn about latest trends, opportunities and good practices in energy• Acquire general knowledge of financing options for ESM• Calculate the costs of employees who oversee the company's energy efficiency• Oversee the implementation of ESM and their payback periods, and benefits achieved• Know what other measures were proposed by the audit	<ul style="list-style-type: none">• Latest trends, opportunities, and good practices in energy, with specific focus on relevant industrial sector• ESM implemented most often in relevant industrial sector• Regulatory obligations in relevant industrial sector• Benefits of energy management systems• Identification of company energy costs, their weight in business results, and evolution over time• Analysis to energy audit and identification of optimum solutions• Development of strategy to implement ESM

[9] Top management decision process, June 2023

Staff

Operational staff includes energy managers and technicians. For this group, training should focus mostly on technical issues (types of measures, technical solutions, energy savings), and then complement with knowledge on economic, regulatory, and environmental aspects of ESM. Training programmes for this group can benefit from field visits to companies where ESM and/or energy efficiency technologies have already been implemented.

Skills to develop	Topics to include
<ul style="list-style-type: none">• Technical knowledge on how to achieve energy savings• Ability to promote the implementation of ESM in their company	<ul style="list-style-type: none">• ESM and RES implementation, technical solutions, and benefits• Organizational measures and good practices• Monitoring and analysis of energy consumption• Funding/financing for ESM• Regulatory obligations related to ESM• Carbon footprint and neutrality• Energy management system opportunities

Industry associations and other multipliers

External stakeholders include industry associations (and respective member organizations), industrial energy experts, business/commercial experts, economists, managing authorities, and other professionals working in (or closely with) industrial energy efficiency. These stakeholders are expected to be able to detect, propose, and promote the implementation of energy-saving measures in companies.

Skills to develop	Topics to include
<ul style="list-style-type: none">• Learn about latest trends, opportunities, and good practices in energy efficiency• Learn about regulation related to ESM and energy audits in industry• Learn about most common barriers to the implementation of ESM in industry and paths to overcome them	<ul style="list-style-type: none">• Latest trends, opportunities, and good practices in energy, with specific focus on relevant industrial sector• Existing and foreseen regulatory obligations (at EU and local level) affecting relevant industrial sector• Development of strategies to implement and/or support the implementation of ESM

FINDING EXTERNAL SUPPORT TO IMPLEMENT ESM

The implementation of ESM identified in energy audits requires resources from multiple departments inside a company – and often also support from external experts. However, several companies reported lack of time and / or specific knowledge among general staff to make the most out of the services of energy auditors and other external service providers [10].

The AUDIT2MEASURE project addresses this knowledge barrier by providing tailored support to companies struggling to implement ESM. This support is arranged by energy, financial, and technical experts and auditors, financial and research institutions, manufacturers, ESCO, legal experts, and national and local authorities.

Besides direct support, the AUDIT2MEASURE project also offers a knowledge exchange space to foster collaboration, networking, and discussion among national industry players, policy developers, and research institutes. This platform encourages the exchange of experiences and collaborative learning about best practices, success cases, and challenges of the implementation of ESM in companies. Lessons drawn from these exchanges may be particularly beneficial for Small and Medium-sized Enterprises (SME), which may not have as many resources/expertise as larger companies to develop future policy measures.

KNOWLEDGE EXCHANGE SPACE	<ul style="list-style-type: none">• Articles• Reports• Case studies• ESM database	<ul style="list-style-type: none">• 1-1 discussion• Audit results• Tailored advice	NON-PUBLIC EXCHANGE SPACE
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The AUDIT2MEASURE knowledge exchange space

[10] Report of barriers affecting the uptake of ESM in companies, July 2023

SUPPORTING COMPANIES

THE AUDIT2MEASURE SUPPORT SCHEME

Technical support

Information and advice on measuring/calculating energy savings, tailored training courses, knowledge exchange and use cases.

Economic-financial support

Training on calculating economic viability of ESM, advice on ESM costs (CAPEX and OPEX) and financing options.

Regulatory and legal support

Advice about specific regulations and laws affecting ESM, first steering overview of the present national policy framework.

Behavioral and cultural change

Training on energy cultural change and advice on how to achieve it, steering coaching on the benefits of change.

Contact your national representative at the AUDIT2MEASURE consortium to arrange support for your company.

Contact list at the end of this document.

SELF-ASSESSMENT OF ENERGY MANAGEMENT AND ISO 50001

ENERGY MANAGEMENT SYSTEM (EMS)

Systematic approach to manage an organization's energy consumption and lower energy costs. It comprises interrelated or interacting elements, such as policy, objectives, energy targets, energy baselines, energy performance indicators, internal audits, procurement processes, and design.

ISO50001

Global standard that outlines the requirements for building, implementing, maintaining, and upgrading an EMS. The standard is based on the Plan-Do-Check-Act (PDCA) cycle and serves as a framework for the ongoing energy performance improvement, while being adaptive and flexible to diverse types of organizations, regardless of size, sector or location.

Assessing the maturity level of a company's EMS and ISO50001 is all-important for the success of an energy-saving measures implementation plan. Maturity models assist organizations in determining their current level of energy management maturity across the entire spectrum of their energy management practices, establishing objectives for improving their performance, and identifying the practices that require improvement; the maturity level of ISO50001 focuses on evaluating the implementation of the EMS itself, supporting improvements that increase the efficiency of the ESM implementation strategy.

1

Structured understanding of energy management practices

2

Understanding of the steps to successful energy management

3

Development of a roadmap for continuous improvement

4

Benchmarking of energy practices in external organisations

5

Adoption towards certification

Steppingstones to achieve ISO50001 certification

The AUDIT2MEASURE project proposes a maturity model questionnaire to help companies assess their position in the implementation of energy management activities and evaluates energy management practices based on a set of standard requirements.

The AUDIT2MEASURE Energy Management maturity self-assessment tool divides into seven sections in accordance with ISO50001 requirements, namely the organizational context, leadership, planning, support, operations, performance evaluation, and continuous improvement. In each category, the company assesses the tasks and subtasks designated by the standard as necessary for certification in terms of level of implementation, scoring from zero to four, in increasing levels of maturity.

Standard requirements behind the EMS maturity model questionnaire	
Energy policy objectives	The company's energy policy should be aligned with the ISO50001 requirements and establish measurable and consistent energy objectives.
Energy planning	The company should have a comprehensive energy plan that includes a baseline energy consumption assessment, energy performance indicators, and energy management action plans.
Energy review	The company should conduct regular energy reviews to identify energy saving opportunities, assess energy performance, and monitor progress towards its energy objectives.
Energy performance indicators (EnPIs)	The company should have established EnPIs that measure energy performance and enable monitoring of progress towards energy objectives.
Energy management system documentation	The company should have documented policies, procedures, and records demonstrating compliance with ISO50001 requirements.
Management responsibility	Senior management should demonstrate leadership and commitment to the EMS, including by providing resources and meeting energy objectives.
Employee awareness and training	Employees should be aware of the company's energy policy, objectives, and energy management action plans. They should also be trained on how to operate equipment and systems in an energy-efficient manner.
Performance assessment	The company should regularly evaluate the effectiveness of its EMS and take any necessary corrective actions.

ENERGY EFFICIENCY

THE IMPLEMENTATION CHECKLIST

WHAT	WHO
Energy audit	Internal / external auditor
Assessment of energy audit outputs (proposed ESM and Energy Management Plan)	Energy manager and/or Management Board
Ranking of proposed ESM according to the Audit2Action model	Energy manager and/or Management Board
Allocation of funds / research of funding options	Management Board / Financial manager
Research on external support agents	Financial manager / Energy manager
Training of stakeholders	Energy manager / External support partner
ISO 50001 certification	Energy manager / External support partner
Self-assessment of Energy Management System maturity level + improvement plan	Energy manager

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