



AUDIT2MEASURE

D3.1 The Audit2Action Strategy: a new approach to upgrade energy audit outcomes



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ABOUT

Industry is a key player in energy consumption and economic impact in the European Union (EU) and energy audits represent an important tool to improve energy efficiency in the sector; despite both the spread of energy audits and the knowledge of their benefits, the actual implementation rate of the Energy Savings Measures (ESM) proposed by energy audits is relatively low. **The main aim** of the AUDIT2MEASURE (Leading businesses towards climate neutrality by speeding up the uptake of energy efficiency measures from the energy audits) project **is to support companies in the uptake of audits measures necessary to reduce the energy consumption supporting their energy transition**. AUDIT2MEASURE should develop and implement a new engagement strategy (called “Audit2Action”) to put into action the opportunities emerging from energy audits.

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ABBREVIATIONS

A2M	AUDIT2MEASURE
A2A	Audit2Action
EED	Energy Efficiency Directive of the European Union
EMS, EnMS	Energy Management System(s)
EPC	Energy Performance Contracting
ESM	Energy Saving Measure(s)
ESCO	Energy Service Company
GHG	Greenhouse Gas
HVAC	Heating, ventilation and air conditioning
ISO	International Organization for Standardization
KES	Knowledge Exchange Space
KPI	Key Performance Indicators
NEEAP	National Energy Efficiency Action Plan
NEB(s)	Non-Energy Benefit(s)
RE	Renewable Energy
SME(s)	Short and Medium size Enterprise(s) (EU definition)
CHP	Combined Heat and Power
M&D	Monitoring and Diagnostics
ER	Energy Recovery

EXECUTIVE SUMMARY

This Audit2Action strategy is a guide for companies including information and tools of the AUDIT2MEASURE project which objective is to support industries for the choice consideration and implementation of energy saving measures (ESM) that have been recommended in the energy audit.

This strategy addresses informational, behavioural, organizational and economic barriers affecting the uptake of the ESM.

The structure of this strategy includes general information in three chapters that are Executive summary, Context and Scope of the A2A Strategy; other chapters with more specific information include Outputs of the energy audits, Non-Energy Benefits of ESM and Key information to select ESM; Funding, Capacity building, Getting support for application of the ESM and Assessment of company about EMS and ISO50001.

The article 8 of the Energy Efficiency Directive (EED) (Directive 2012/27/EU) ruled the very first energy audit obligation for “large enterprises” through compliance criteria; obligated enterprises must conduct a valid energy audit at least every 4 years.

In addition to this, it is stated in the EED that “Member States shall develop programmes to encourage SMEs to undergo energy audits and the subsequent implementation of the recommendations from these audits”; also, they may set up support schemes for SMEs to cover costs of an energy audit and of the implementation of highly cost-effective recommendations from the energy audits, if the proposed measures are implemented.

The characteristics of this document are:

- Meant for companies, to be priority read and used by management level staff, involved in the strategy of the companies;
- Including key information that it is useful to implement their ESM of the energy audits;
- Friendly reading.

This strategy is aimed mainly at medium to high level management (from heads of department to directors) but that could be also used by energy leaders in the companies at other levels (as operational staff with large experience in a certain energy service) to find out innovative solutions.

It includes key information from technical, economic and financial issues to implement ESM identified mainly by the energy audits.

This document has been written using understandable language for managerial and technical staff of the companies.

The main tools that A2M project will provide to support the strategy and help overcome the barriers for implementing ESM are:

- The **benchmarking system of energy saving measures** based on the assessment of KPIs;
- The **extended database of ESM**;
- The **capacity building programme**;

- A tool for companies to self-assess the maturity of various aspects of their energy management process according to the ISO 50001 standard;
- Getting **direct support for ESM implementation** for the engaged companies;
- **Knowledge Exchange Space**, KES for findings, ideas and experiences of ESM.

The **benchmarking system** for the assessment of ESM, based on a series of KPIs, including non-energy and of non-financial benefits (KPIs database population). NEBs are also included as key parameters within the ESM assessment process and could be classified into 6 categories, such as: production, operation and maintenance, work environment, waste and water, emissions and others; this strategy includes more relevant information of the NEBs.

The **extended database** of ESM will be organized in technology groups (e.g. lighting, compressed air, etc.) and will be ranked considering their effectiveness about energy cost, environmental impacts and NEBs.

A questionnaire will be developed based on an energy management maturity model developed by A2M, according to which the companies will be able to conduct the self-assessment. Moreover, the additional steps that companies can make to improve their performance and realise the potential from stepping up from an energy audit, to ISO 50001 adoption and full implementation are highlighted through this assessment process.

The **capacity building programme** for companies and industrial associations will include a range of meeting and workshop-based activities together with the direct support to industries. Concerning the meeting- and workshop-based activities, they encompass:

- bilateral meetings for laboratory of ideas with companies focus to management and decision makers;
- training courses for operational staff;
- training workshops with industrial associations;
- training workshop for energy experts.

The above mentioned bilateral meetings aim at linking energy efficiency with companies' strategic objectives to identify solutions and gain their commitment for the ESM implementation.

Courses for operational staff will be organised in the project participant countries to help companies implementing ESM; furthermore, engaged companies will get information and direct advice for the ESM implementation.

Direct support to a group of engaged companies and related stakeholders for ESM implementation (in-field activities).

The project provides to the engaged companies technical, economic-financial and legal advice and support; also, advice on the specific information of the potential changes of energy behaviour and how to achieve them.

All documents and tools developed by the A2M project that could be useful for companies will be available in the project website¹ or in the KES.

A secured **Knowledge Exchange Space (KES)** will be available that will allow industry players to share their knowledge, experiences, findings and ideas on ESM which should result

¹ A2M project website <https://ieecp.org/projects/audit-to-measure/>.

in a more efficient use of their time and resources and lead to significant energy savings in the end.

The KES fosters collaboration and general networking/discussion among (national) industry players, also involving policy developers and/or research institutes at the national and international level. By facilitating this exchange, it should allow them to learn from each other's successes and failures through sharing of experiences, companies and policymakers are supported in identifying best practices and solutions that are tailored to their specific needs and challenges and are proven to work.

Financing by third parties for energy saving measures of the energy audits is sometimes required by the companies. Different financing lines from private loans to public financing programmes are available in the countries at national or local levels; the strategy briefly includes information of relevant EU funding programmes and financing instruments also private fundings that usually come from private bank loans, companies that provides EPC model for the required investments for financing the new equipment or new systems.

1. THE CONTEXT

The 2007 action plan of the European Commission for an Energy policy in Europe targeted a 20% reduction of greenhouse gas emissions as compared to 1990. Increasing the use of renewable energy and expanding energy efficiency by 20% were two of the main targets that were included in the plan. This was continued in the first Energy Efficiency Directive (EED) adopted by the European Union in 2012 (Directive 2012/27/EU)² which included a variety of measures to achieve the goal of saving 20% of primary energy by 2020. The EED contains the development of national policies and schemes to reduce national energy sales, accelerate energy efficient renovations of building stocks, set minimum energy performance standards for household appliance and increase awareness on the individual energy consumption of households and enterprises. The different member states implemented these requirements in their national legislation and have to monitor and report them every 3 years in their National Energy Efficiency Action Plans (NEEAPs)³.

Article 8 of the EED⁴ published in 2012 set the first energy audit obligation for enterprises; it also defined compliance criteria for energy audits and auditors drawing on European and international standards such as EN 16247 and ISO 50001. Obligated enterprises must conduct a valid energy audit at least every 4 years (Article 8 of the EED requires all “large enterprises” to carry out energy audits, however most surveyed countries have introduced energy intensity criteria in addition to the definition of non-SME according to the EU).

The new Regulation on the governance of the energy union and climate action (Regulation (EU) 2018/1999)⁵ adopted in 2019 requires Member States to establish National Energy and Climate Plans (NECPs) for the 2021-2030 period, integrating energy efficiency, renewable energy and GHG emissions reduction targets for 2030. In 2021 the European Commission released a proposal for a renewal of the EED⁶ as a part of the European Green deal. It raises the targets to 39% primary energy reduction and 55% GHG emissions reduction by 2030 as compared to 2020. It also suggests changing the definition of the target group for mandatory energy audits from employer-size-based criteria (drawing on the EU definition of SMEs) to an energy intensity threshold and includes an obligation to implement an energy management system for highly energy-intensive companies. It is expected to come into

² Directive 2012/27/EU on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC. Retrieved 01.03.2023 from [L_2012315EN.01000101.xml \(europa.eu\)](https://eur-lex.europa.eu/eli/dir/2012/27/oj).

³ Chapter V – Final Provisions, Article 24 – Review and monitoring of implementation. In: Directive 2012/27/EU on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC Retrieved 01.03.2023 from [L_2012315EN.01000101.xml \(europa.eu\)](https://eur-lex.europa.eu/eli/dir/2012/27/oj).

⁴ Chapter II – Efficiency and energy use, Article 8 – Energy audits and energy management systems. In: Directive 2012/27/EU on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC. Retrieved 01.03.2023 from [L_2012315EN.01000101.xml \(europa.eu\)](https://eur-lex.europa.eu/eli/dir/2012/27/oj).

⁵ Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council. Retrieved 01.03.2023 from [EUR-Lex - 32018R1999 - EN - EUR-Lex \(europa.eu\)](https://eur-lex.europa.eu/eli/reg/2018/1999/oj).

⁶ Proposal for a Directive of the European Parliament and of the Council on energy efficiency (recast). Retrieved 01.03.2023 from [EUR-Lex - 52021PC0558 - EN - EUR-Lex \(europa.eu\)](https://eur-lex.europa.eu/eli/reg/2021/PC0558/oj).

action by 2024; it will not include an obligation to implement certain ESM although, some member states already included similar obligations in their national legislation.

The definition of a “State of the Art” of the auditing system in the partners’ countries involved in the project is fundamental for the A2M activities, to build a solid Audit2Action engagement strategy and tailor the actions with the companies consequently.

To this aim, an analysis of the current auditing system and ESM implementation in the most relevant industries in each represented member state is being carried out, based on desk research and a series of questionnaires to analyse company’s strategy and top management decision processes and assess the informational, behavioural, organizational and economic barriers affecting the uptake of ESM.

According to the companies, the most recommended measures are in the area of lighting, processes, process heating and cooling, heating and air conditioning and power generation as shown in Figure 1. The surveyed auditors were asked to name ESM that are recommended (economically or in terms of impact) to their area of focus in the industry: Figure 2 shows which ESM where most frequently recommended by surveyed auditors⁷. Likewise, lighting is still reported as the most recommended category by auditors, followed by heating and air conditioning, compressed air, power generation, drives/motors and pumps and information and communication technology. Companies have implemented measures mainly in lighting. Heating and air conditioning, processes and power generation follow at a much greater distance, as you can see in Figure 3. In the remaining areas, the companies surveyed have implemented even fewer measures. In general, except for lighting, there is a clear implementation gap in all other ESM areas.

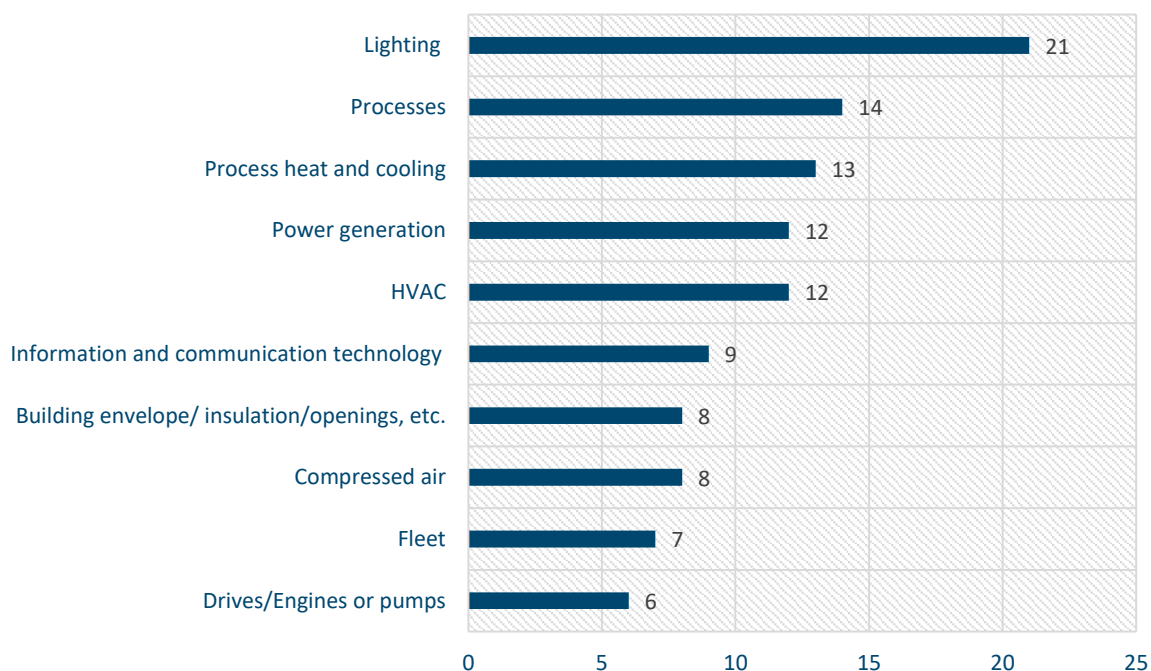


Figure 1: Most frequently recommended ESM (categories) to 31 surveyed companies (Source: A2M D2.2 Report).

⁷ This ranking however does not indicate which ESM technologies have the highest economic and energy-savings impact, but rather how frequently an ESM technology is relevant e.g. would be recommended by surveyed auditors.

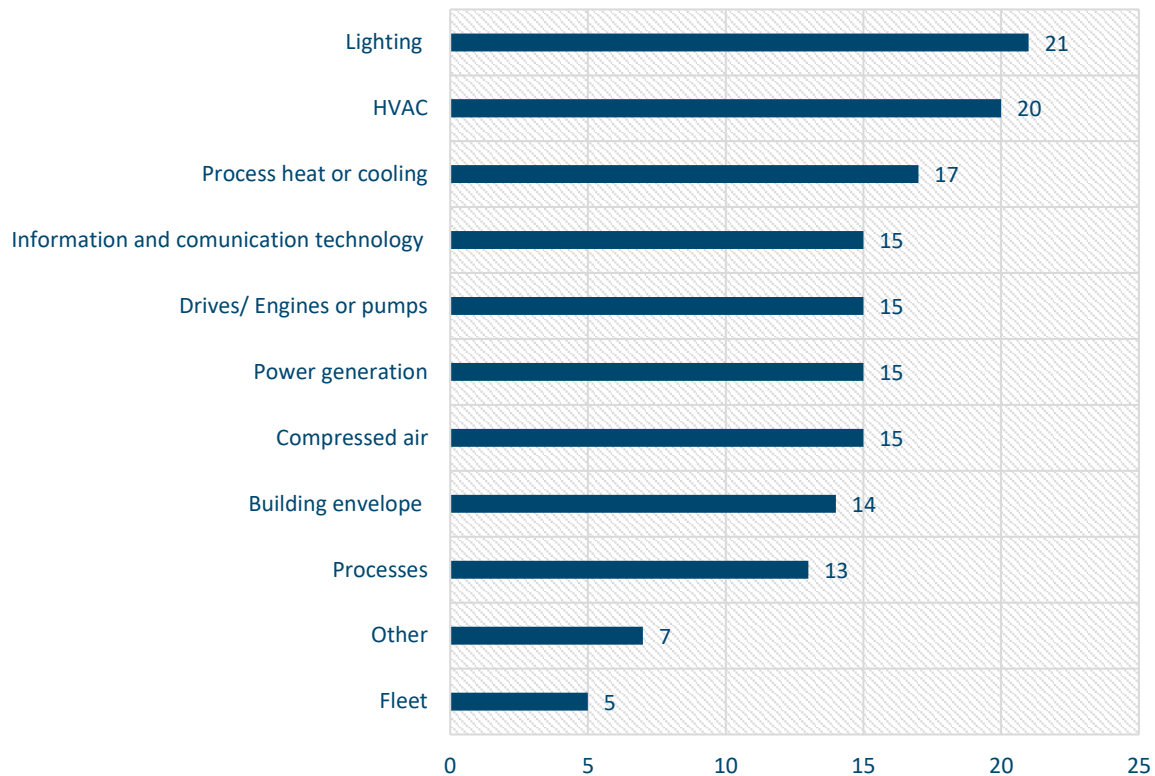


Figure 2: Most frequently recommended ESM (categories) according to 35 surveyed energy auditors (Source: A2M D2.2 Report).

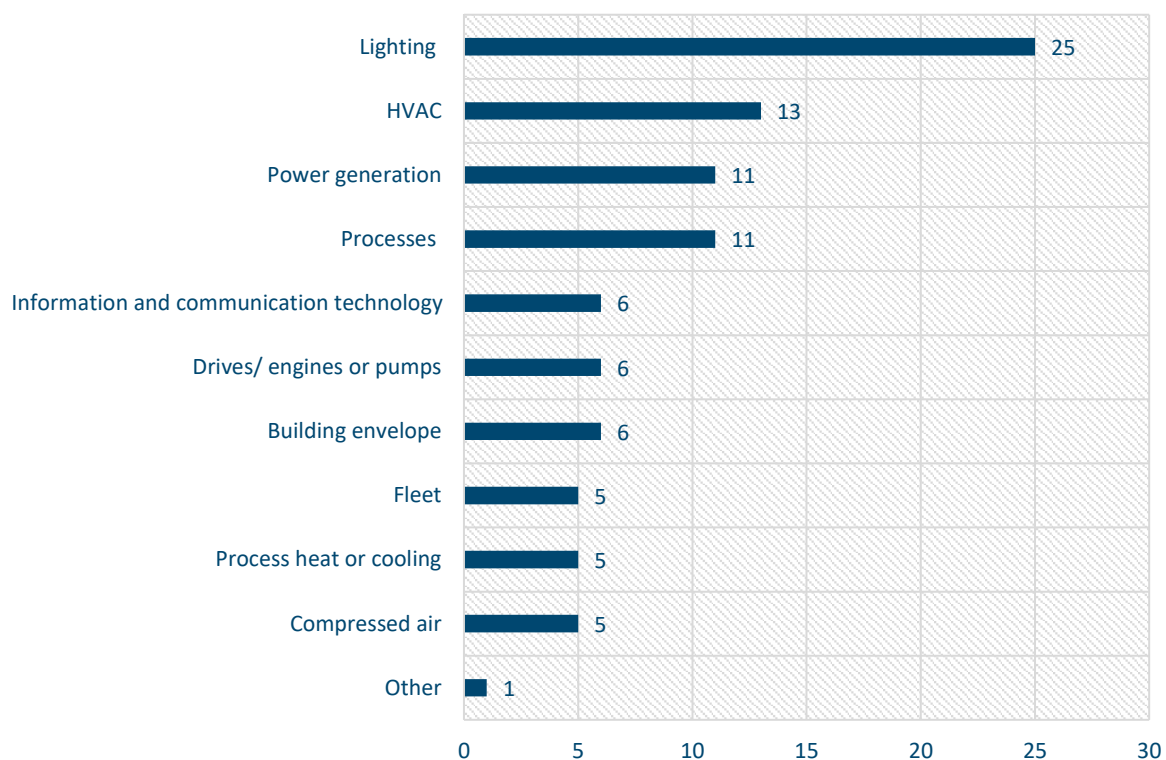


Figure 3: Most frequently implemented ESM (categories) in 31 surveyed companies (Source: A2M D2.2 Report).

In most cases, the companies interviewed in the project stated that it was the board of directors that made the decision to invest in ESM in the company. In very rare cases, these decisions are also made by middle or lower management or the technical department. This

can also mean technical management or specific energy management. In general, the decision-making process is very often top-down. The management sets sustainability or energy saving targets and asks the technical department or, if it exists, the energy department of the company to evaluate their existing processes and identify energy saving potentials, if this has not already been done in the energy audit. The possible ESM are proposed to the management. Finally, the most promising measures are implemented. Certain indicators play a role in the evaluation. According to the companies surveyed, the most important indicator is the potential for energy cost reduction, followed by investment costs, payback periods and the potential for CO₂ reduction. The availability of subsidies and interest in climate protection are also highlighted as important indicators.

According to the company survey, the most common barriers to implement ESM are of economic and organisational nature. The most common perceived barrier is the lack of financial resources: 27 of the 31 companies surveyed rated this barrier as, at least, rather relevant. This was followed by a lack of human resources, lack of time and difficulties to change existing routines. This is confirmed when looking at the most frequent reasons for non-implementation: high-investment costs, long payback periods, other priorities, lack of funding, lack of resources, lack of time. The auditors, indeed, found out that it is mainly the prioritisation of other expenses and the high investment costs that prevent companies from ESM implementation. Long payback periods and the lack of availability of subsidies also play a role. Lack of resources and time are not seen as major barriers by the auditors.

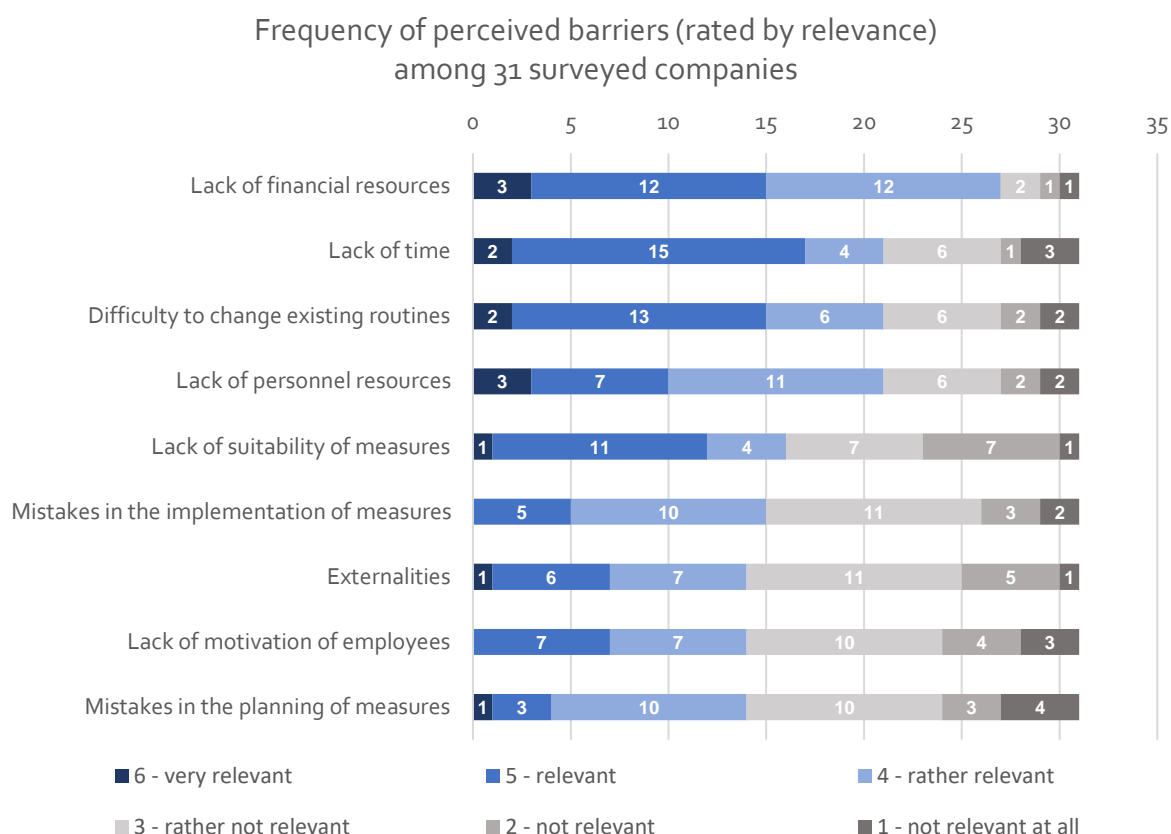


Figure 4: Perceived barriers according to 31 surveyed enterprises (Source: A2M D2.3 Report).

Frequency of actual barriers (i.e. reasons for non-implementation) among 31 surveyed companies

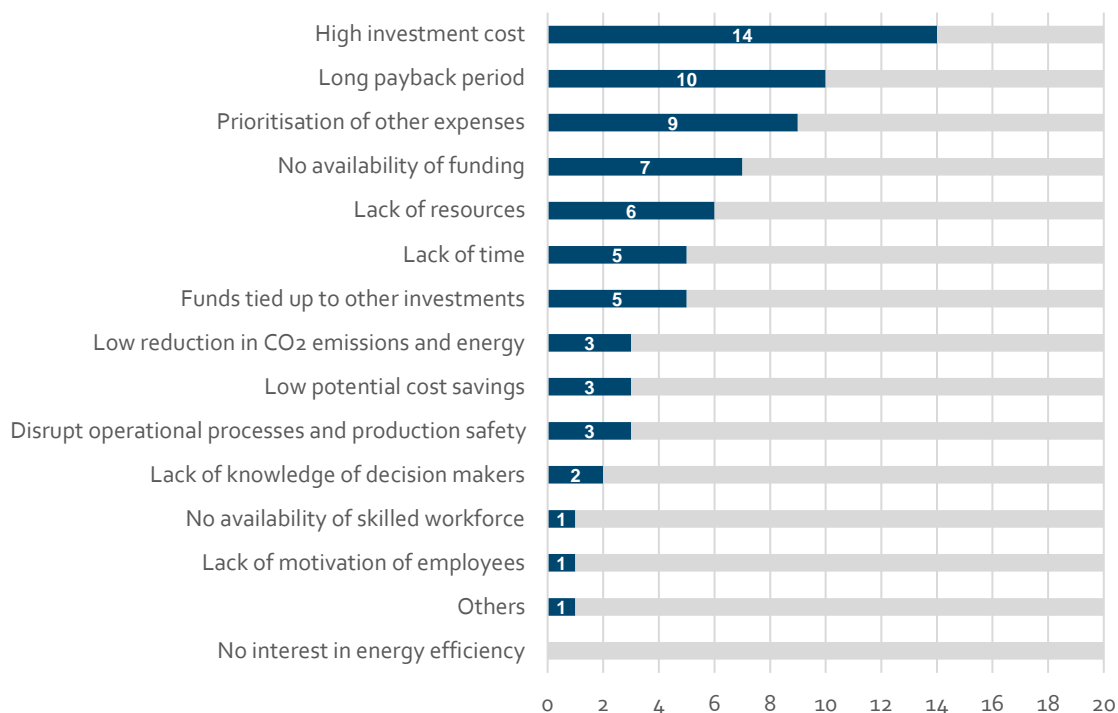


Figure 5: Reasons for non-implementation (i.e. perceived barriers) according to 20 surveyed enterprises (Source: A2M D2.3 Report).

In summary, as evidenced by the conducted surveys, the most recommended ESM in companies concern the following macro-areas: lighting, processes, process heating and cooling, heating and air conditioning, as well as power generation. Unfortunately, apart from the lighting category, the gap among the recommended and implemented ESM is still rather remarkable. While, as regards the decision-making process of ESM implementation, the survey suggests that this latter one usually follows a top-down approach, where the targets at energy and at environmental level are set by managers, whereas the ESM identification, feasibility assessment and implementation process are performed either by the energy department or by the operational staff. In addition, beside of the decision-making hierarchy, also the key-factors affecting the ESM uptake decision-process have been investigated. As evidenced by the extracted data, energy cost reduction seems to constitute the most important indicator, followed in decreasing of importance order by the investment costs, the payback period and the potential for CO₂ reduction. Also, the availability of subsidies and interest in climate protection go along with the above-mentioned drivers. Finally, the survey results have highlighted that, as confirmed by the most frequently reasons for non-implementation, the most common implementation barriers at stake are of economical and organizational nature.

2. SCOPE OF THE AUDIT2ACTION STRATEGY

The main goal of the Audit2Action Strategy is to provide a practical framework to support industrial companies in the uptake of the ESM identified through energy audits, aiming primarily at reducing their energy consumption and thus supporting their energy transition.

The strategy is a guide for companies including information and tools of the A2M project which objective is to support industries for the choice consideration and implementation of energy saving measures that have been recommended in the energy audit.

This strategy addresses informational, behavioural, organizational and economic barriers affecting the uptake of the ESM. The A2A Strategy includes relevant information of a capacity building program for high, intermediate and low-level managers within the companies, in order to accelerate the uptake of the energy audit outcomes. In order to promote cross-fertilization among different stakeholders in and outside the companies, a stakeholder analysis & engagement plan (SAEP), which is addressed not exclusively to companies, rather to professionals and industry associations as well, has been launched.

The mentioned coordinated involvement of companies' management and of engaged energy professionals (energy staff, energy auditors, energy consultants, etc.) at the various levels of the energy management process represents a key element for the Audit2Action Strategy. In this context, the strategy aims at empowering target companies, by helping them:

- in acquiring a concrete grasp on the identification of the barriers, which hinder the implementation of ESM;
- in leveraging knowledge, know-how and tools to develop skills aiming at overcoming and at managing the barriers-related risks;
- in increasing the ESM ranking in the investment priorities of the decision makers.

In this regard, the capacity building program will enable companies and their associations to develop an energy management culture and gradually adopt behavioural and organizational changes needed to promote energy saving and energy efficiency.

The main tools that A2M project will provide to support the strategy and help overcome the barriers for implementing ESM are:

- The benchmarking system of ESM based on the assessment of KPIs;
- The extended database of ESM;
- The capacity building programme;
- Getting direct support for ESM implementation for the engaged companies;
- Knowledge Exchange Space, KES for findings, ideas and experiences of ESM.

The **benchmarking system** for the assessment of ESM, based on a series of KPIs, including non-energy and of non-financial benefits (KPIs database population). NEBs are also included as key parameters within the ESM assessment process and could be classified into 6 categories, such as: production, operation and maintenance, work environment, waste and water, emissions and others; this strategy includes more relevant information of the NEBs.

The **extended database** of ESM will be organized in technology groups (eg. lighting, compressed air, etc.) and will be ranked considering their effectiveness about energy cost and NEBs.

Maturity Management Model is being developed to investigate and assess the mindset of decision markers in companies towards energy efficiency issues together with that of ISO 50001 (its standard-based energy management maturity model).

The **capacity building programme** for companies and industrial associations will include:

- bilateral meetings for laboratory of ideas with companies focus to management and decision makers;
- training courses for operational staff;
- training workshops with industrial associations.

Linking energy efficiency with companies' strategic objectives to identify solutions and gain their commitment for the ESM implementation with bilateral meetings.

Courses for operational staff and energy experts will be organised in the project participant countries to help companies implementing ESM; furthermore, engaged companies will get information and direct advice for the ESM implementation.

Direct support to a group of engaged companies and related stakeholders for ESM implementation (in-field activities). The project provides technical, economic-financial and legal advice and support to the engaged companies; also, advice on the specific information of the potential changes of energy behaviour and how to achieve them.

Moreover, the A2M project develops several documents and tools that could be useful for companies and will be available in the project website⁸ or in the KES. A secured **Knowledge Exchange Space (KES)** will be available that will allow industry players to share their knowledge, experiences, findings and ideas on ESM which should result in a more efficient use of their time and resources and lead to significant energy savings in the end.

The KES fosters collaboration and general networking/discussion among (national) industry players, also involving policy developers and/or research institutes at the national and international level. By facilitating this exchange, it should allow them to learn from each other's successes and failures through sharing of experiences, companies and policymakers are supported in identifying best practices and solutions that are tailored to their specific needs and challenges and are proven to work.

⁸ A2M project website <https://ieecp.org/projects/audit-to-measure/>.

3. OUTPUTS FROM THE ENERGY AUDITS

The outputs of an energy audit in an industrial setting typically ESM include the following:

1. Energy consumption data: a detailed analysis of the energy usage in the industry, including the breakdown of energy consumption by source (e.g., electricity, natural gas, fuel oil, etc.), department and equipment;
2. Identification of ESM: an energy audit typically identifies potential ESM, such as equipment upgrades, process improvements and behavioural changes to reduce energy consumption and improve energy efficiency;
3. Cost-benefit analysis: a cost-benefit analysis is typically conducted for each energy-saving opportunity identified in the audit. This analysis estimates the costs associated with implementing the opportunity and the potential energy savings, enabling decision-makers to prioritize which opportunities to pursue;
4. Recommendations: based on the audit results, the auditor will provide recommendations for energy-efficient equipment, systems and processes that can help the industry save energy and reduce costs;
5. Energy management plan: the energy audit may also provide recommendations for developing an energy management plan, which is a comprehensive strategy for managing energy usage in the industry over the long term. The plan may include specific energy-saving goals, performance metrics and a roadmap for achieving those goals.

An example of the information extracted from a typical energy audit is shown in Figure 6:

1. *Details of the members of the Energy Audit team;*
2. *Detail Information of the audited company;*
3. *Existing situation in the company: General information & operating equipment-processes and final production;*
4. *Analysis of energy consumption of production process (Electrical-Thermal-Water);*
5. *Interpretation of the overall energy efficiency and monitoring of energy indicators (Energy Baseline: Electrical & Thermal energy);*
6. *Life Cycle Cost Analysis – Analysis of the proposed Energy Saving Measures;*
7. *Appendices with all calculations, technical data, etc.*

Figure 6: Indicative outline of an energy audit report, as mandated in Greece, following the standard EN16247 and national legislation (Joint Ministerial Decree N 175275/2018).

Overall, the outputs of an energy audit in an industrial setting can help companies reduce their energy consumption, save money on energy costs and improve their environmental sustainability. However, since it has been noted that the taking charge of the energy audits is still limited, these benefits are rarely fully exploited. For this reason, the A2A strategy hooks up the energy audits outputs trying to increase the implementation rate of ESM.

An ESM is a project or technology implemented to reduce final energy consumption in an industrial facility and can be broadly categorized into different groups such as operational improvements, equipment upgrades, building improvements, renewable energy or behavioural changes. Further details concerning the aforementioned groups can be found below:

1. **Operational improvements:** This category includes measures such as optimizing process design, improving process control and reducing energy waste. Examples of operational improvements include implementing equipment automation and control systems, improving maintenance and inspection practices and optimizing production scheduling.

2. Equipment upgrades: This category includes measures such as upgrading to high-efficiency equipment, optimizing the operation of existing equipment and reducing equipment downtime. Examples of equipment upgrades include upgrading to high-efficiency motors, pumps and compressors, retrofitting existing equipment with energy-saving technology and implementing regular equipment maintenance and inspection programs.

3. Building improvements: This category includes measures such as improving building insulation, upgrading lighting systems and optimizing heating, ventilation and air conditioning (HVAC) systems. Examples of building improvements include replacing old, inefficient lighting systems with LED lighting, improving building insulation to reduce energy losses and upgrading HVAC systems to more efficient equipment.

4. Renewable energy: This category includes measures such as incorporating renewable energy sources, such as solar or wind power, into the facility's energy mix. Examples of renewable energy measures include installing solar panels on the facility's roof, utilizing wind turbines to generate electricity and utilizing biogas from waste streams.

5. Behavioural changes: This category includes measures such as promoting energy-efficient behaviour among employees and encouraging them to adopt energy-saving practices. Examples of behavioural changes include implementing employee education and training programs, incentivizing energy-saving behaviour and utilizing energy-saving labels and signage throughout the facility.

Overall, categorizing ESM in industrial sectors can help decision-makers prioritize and implement the most effective energy-saving strategies for their specific needs and goals. A generic description of some ESM examples can be found in Figure 7 below:

Energy management systems (EMS): It refers to upgrading the operating automated control system used to meet operations conserve energy. It is known in the literature that a well-operated EMS can support industry in saving electrical and thermal energy by at least 10%.

Combined Heat and Power (CHP): The simultaneous production of electrical/mechanical energy and useful thermal energy in one process (CHP) can be a critical EE technology in many industrial processes.

Energy recovery (ER): Energy recovery is one way of minimizing the thermal losses by using a heat exchanger (i.e., economizer) and/or air pre-heater for a boiler or by insulating surfaces rejecting heat to atmosphere, by upgrading roofs and introducing wall insulation, as well as installing energy-efficient windows and doors, of low U-values, to meet local building standards.

Power upgrades and quality improvements, including motors & drives: Upgrading power equipment and understanding power quality is an essential step in any 'company's energy-saving plan. Poor power quality can cause issues inside a facility, costing money. On the other hand, things like improving power factor and load balancing can increase efficiency in electrical energy.

HVAC equipment upgrades, including boilers, burners, etc.: Upgrading HVAC equipment can greatly increase return on investment. Often, when HVAC systems are operating for a long time, they need to be commissioned in-depth or replaced with new of higher EER to operate more efficiently. It is important to note that the EU promotes heat pumps for covering heating, cooling and DHW needs, considering them as a «RE» system.

Renewable Energy generation: One of the most popular RE is Photovoltaic or PV solar system, as solar energy is a great way to generate "green" electricity. Another RE which can assist industries in saving energy is an active solar collector system, used for producing hot water or even steam, used for industrial processes.

Lighting Upgrades: One of the most popular ESM is lighting upgrades. Often companies look to improve their lighting from outdated or old lighting (incandescent or fluorescent lamps) to newer technologies such as LED. Other ESM in lighting could include sensors for controlling lighting through motion and skylights for natural lighting.

Figure 7: Specific yet indicative examples of ESM.

The impact of energy efficiency measures in terms of energy savings on several sectors of European industries, according to NTUA research, is illustrated in Table 1:

Table 1: Impact of ESM in different sectors of the industry.

Industries	Agrofood	Breweries	Bricks	Cement	Ceramics	Chemical	Glass	Iron & Steel	Non-ferrous Metals	Paper	Textiles
EE Technology	Agrofood	Breweries	Bricks	Cement	Ceramics	Chemical	Glass	Iron & Steel	Non-ferrous Metals	Paper	Textiles
EMS											
CHP											
ER											
M&D											
Burners											
Boilers											
RE											
				Very high impact							
				High impact							
				Moderate impact							

4. NON-ENERGY BENEFITS OF THE ESM

Energy experts and industrial companies discuss energy efficiency projects and the potential energy savings are in focus, but the value of secondary effects of these projects can be just as high or even higher. Such secondary effects are typically referred to as NEBs.

Examples are reduced waste, reduced emissions, reduced maintenance costs, a better working environment and reduced production downtime. NEBs are traditionally not included in the economics of energy efficiency project implementation since there is no commonly recognized method for calculating their value, nor has the area been prioritized. However, research indicates that if NEBs are included, the true value of the energy efficiency projects might be up to 2.5 times higher than if looking at the energy efficiency improvements alone.

The most common NEBs of the industrial sector could be classified in 6 categories: production, operation and maintenance, work environment, waste and water, emissions and others. The Table 2 shows most common NEBs that are usually found in the industries⁹.

Table 2: Non-Energy Benefits in industries.

	NEBs	Indicators (examples)
Production	<ul style="list-style-type: none"> Increased productivity (about more units per hour of one product). Reduced production costs (including labour operations and maintenance, raw materials). Improved product quality (reduced scrap/rework costs, improved customer satisfaction). Improved capacity utilisation. Improved reliability. Fewer production disruptions. 	<ul style="list-style-type: none"> - More units/hour of products - Reduced cost per produced unit(€/unit) - Better quality - Positive customer satisfaction
Operation and maintenance	<ul style="list-style-type: none"> Reduced operations and maintenance costs, reduced wear of equipment, extended equipment lifetime. Reduced cleaning requirements, reduced operating time, reduced ancillary operations (e.g., degreasing, cut-off, swaging and annealing), reduced downtime. Non-energy operating costs (e.g., decreased staff time). 	<ul style="list-style-type: none"> - Less operation& maintenance costs (€/year; hours) - More lifetime of an equipment (year) - Less cleaning costs (water, energy, work time)
Work environment/ health/safety	<ul style="list-style-type: none"> Improved worker safety (resulting in reduced lost work and insurance costs), reduced need for protective equipment. Improved health and comfort conditions (examples: better lighting and temperature safety/security, avoiding heavy lifts, improved work environment, better aesthetics, reduced glare, eyestrain, better 	<ul style="list-style-type: none"> - Reduced insurance costs (€) - Less protective equipment costs - Suitable work temperature for -adequate work conditions

⁹ "Non-Energy Benefits of Industrial Energy Efficiency, Roles and Potentials", Therese Nehler and Linköping, Studies in Science and Technology, Sweden.

	air quality, better air flow/dust/vapours, reduced noise and less stress). <ul style="list-style-type: none"> Personnel needs, injuries or illnesses (e.g., fewer accidents due to improved lighting), employee morale or satisfaction (e.g., improved lighting and temperature control). 	- Improved air quality - Reduced noise (dB) - Less injuries and illnesses of workers
Waste and water	<ul style="list-style-type: none"> Reduced waste (disposal/waste transport). Reduced water losses and bills . Greater efficiency and control of water use, reduced water use. Reduced overwatering of landscaping. Reduced wasted heat, recycling of the wasted heat available. 	- Less cost of waste disposal or transport (€) - Decreased cost of water use - Eliminate water losses
Emissions	<ul style="list-style-type: none"> Reduced emissions and reduced fines related to emission exceedances. Reduced cost of environmental compliance. Reduced emissions of dust and criteria pollutants, cost savings from avoided mitigation expenses or fines. 	- Reduced CO, CO ₂ , NO _x , SO _x emissions - Reduced dust emissions - Less fines or no fines due emissions (€)
Others: sales, competitiveness, etc.	<ul style="list-style-type: none"> Sales levels (sustainability, customer satisfaction/loyalty, publicity and unique selling points (such as sustainability). Improved competitiveness. Increased asset values. Improved image in society (improve corporate reputation), increased influence on customers. Achievements of rebates or incentives. 	- Increased sales due to reputation, publicity - Better customer satisfaction - More success on rebate achievement

The non-energy benefits included in Table 2 above are mainly benefits perceived on sectoral and individual levels by managerial and operational staff from industries. A more comprehensive analysis representing them all on a qualitative and quantitative (when possible) level is recommendable: it creates a deeper understanding of the ESM' impacts, fosters synergies among different areas and generates a wider support for the initiatives.

Table 3 includes examples of energy efficiency measures and NEBs¹⁰.

Table 3: Indicative examples of energy saving measures and possible generated NEBs.

Energy saving measures	Non-Energy Benefits
Replacement of compressor	<ul style="list-style-type: none"> Improved product quality Less noise levels A new compressor with less volume will provide more space Higher level of comfort for workers due to less noise
Replacement of motors	<ul style="list-style-type: none"> Less noise level

¹⁰ "Spreading the word-An on-line non-energy benefit tool", Erik Gudbjerg, Your Energy, Christina Monrad, Lokalenergi Handel A/S and Kirsten Dyhr-Mikkelsen, Ea Energianalyse, Denmark.

	<ul style="list-style-type: none"> - Productivity improvement - Less need of maintenance
Installation of photovoltaic system, lighting timers, replacement of ventilation, automatic control of hot water circulation.	<ul style="list-style-type: none"> - Better indoor climate and comfort - Has become a landmark in the area - Incorporation of EE experiences in the teaching
Oven replacement	<ul style="list-style-type: none"> - Increased production capacity due to reduced heat losses from the oven - Less temperature in the working space will provide better comfort for workers
Lighting improvement in a factory	<ul style="list-style-type: none"> - Fewer measurement errors - Less shipping mistakes - Better workers conditions

Some studies have published the firms' views on monetisation in relation to the NEBs perceived. Even though several NEBs were observed by the interviewed firms, only about 2/3 were monetised. Reduced operation and maintenance, improved use of waste heat and reduced need for cooling were the non-energy benefits that firms stated were most frequently monetised.

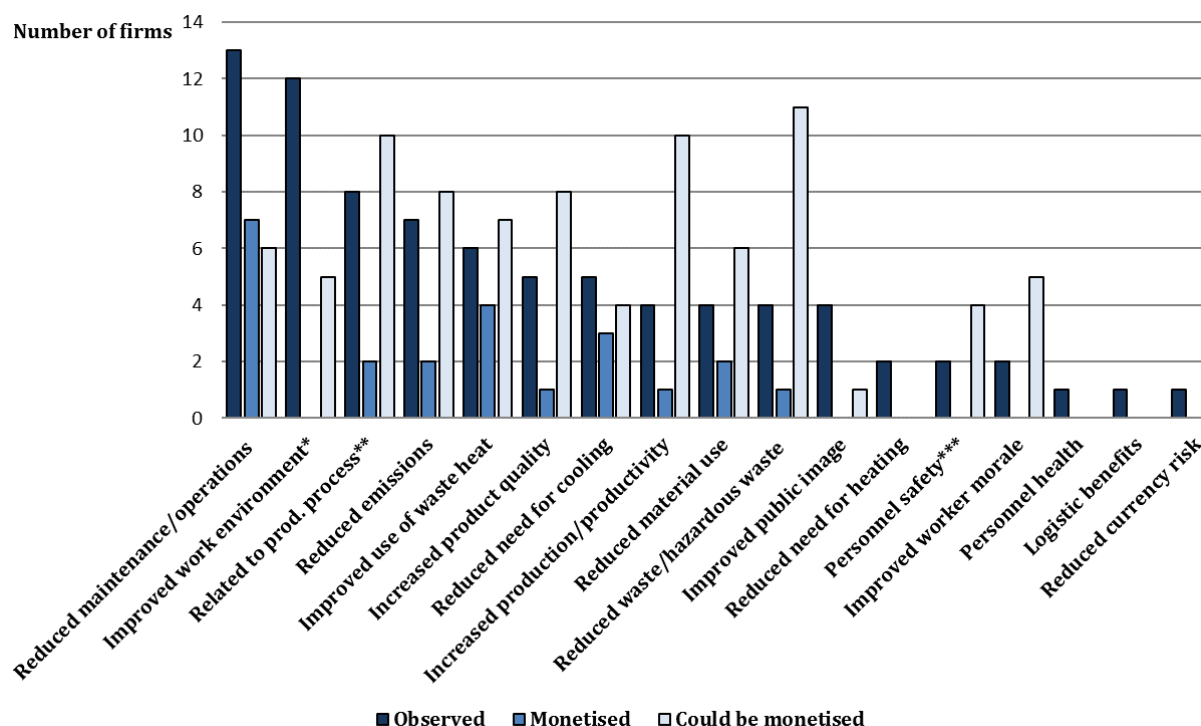


Figure 8: Monetisation of NEBs¹¹.

Many of the non-energy benefits can be considered cost reductions, such as reduced material costs and reduced salary costs, but also cost avoidances, for instance, less sick leave and reduced costs for silencers and noise enclosures. On the other hand, according to the respondents, some of the benefits could also be observed and measured through increased revenue such as increased production and increased productivity.

¹¹ Note: * This benefit includes reduced noise, improved air quality, reduced heat, improved lighting, improved indoor environment and improved temperature control. ** This benefit includes longer equipment lifetime, reduced wear and tear, reduced scrap, fewer production disruptions, process stability and improved reliability in production. *** This benefit includes fewer accidents due to improvements in the work environment and fire protection.

M-Benefits is a European project that have analysed the multiple benefits of energy efficiency (2019-2021); cases and examples are available in the webpage¹².

¹² <https://www.mbenefits.eu/news-resources/library/?f=cases-examples>.

5. KEY INFORMATION TO SELECT ENERGY SAVING MEASURES

An energy audit conducted on a company results in a set of ESM, which decision-makers can prioritise for implementation in either the short or long term.

The selection of ESM is contingent upon various factors, with the most prevalent being the energy saving potential, the environmental impact, the financial viability of the proposed ESM, including payback periods and costs associated with the investment, as well as the technical feasibility and the operational implications of the proposed measures.

Since the goal for an informed investment decision depends on the well-advised prioritization of the proposed energy-saving measures, the A2M project has created a consistent set of KPIs, that include a range of technical, economic and environmental aspects to enable the initial ranking of energy efficiency measures based on their performance against the calculated KPIs. The A2M KPIs are categorized into four main categories:

- Energy KPIs, including, but not limited to, Primary Energy Savings (TOE/Year) and Cost of Energy Savings (€/TOE/year);
- Environmental KPIs, including, but not limited to, Carbon Savings (tCO₂ / Year) and Cost of Carbon Savings (€/tCO₂/ year);
- Financial KPIs, including but not limited to Simple Payback Period;
- Non-Energy Benefits KPIs in terms of Productivity, Operation and Maintenance, Work Environment and Other NEBs.

In order to facilitate the decision-making process, each energy-saving measure is evaluated based on its effectiveness in relation to the other energy-saving measures of the same industrial sector using a KPIs weighting methodology. Also, the score attributed to the four categories is provided in order to allow comparison of different impacts of the same ESM or in relation to the other energy-saving measures. This should help the identification of the best performing measures across different industries and technologies.

With this information, the company can make more informed decisions regarding which energy-saving measures to prioritize and implement, based on their potential to accomplish substantial energy savings, reduce costs, enhance operational efficiency.

The outputs of the KPIs assessment and benchmarking methodology are then stored in the A2M Database and categorized by industrial sector and technology group, in an effort to provide companies with specific, comprehensive, clear and reliable quantitative and qualitative information on the preferred decision criteria (Energy, Environmental, Financial, Non-Energy Benefits) for each ESM. The database also serves as a valuable source of information analyzing expectations or results of energy saving measures applied in different industrial sectors, of different types and in different countries and business context. At a later stage the A2M will also provide a set of executive sheets for selected ESM aiming to highlight their potential and results.

6. FUNDING OPTIONS FOR ESM IMPLEMENTATION

There are several financing options available for energy-saving measures in industry, including:

- **Energy Efficiency Loans:** These loans are specifically designed for energy-efficient projects and are offered by many banks and financial institutions. They typically have lower interest rates and longer repayment terms than traditional loans;
- **Energy Performance Contracts (EPCs):** An EPC is a contract between the facility owner and an energy service provider or Energy Service Company (ESCO). The provider installs energy-efficient equipment and services and the facility owner pays for the project with the energy savings generated;
- **On-bill financing:** This financing option is offered by some utilities and allows customers to finance energy-efficient upgrades on their monthly utility bills;
- **Tax Credits:** Tax credits may also apply in some countries for businesses that invest in ESM;
- **Energy Efficiency Incentives:** these incentives are usually state-owned and reward energy savings due to projects.

It is important to research and compare the different financing options available to determine which option best fits the company's specific energy-saving needs and financial situation. Indeed, funding of ESM can be a crucial success factor for the energy efficiency projects, as many facility managers agree that those projects are suitable investments, as they reduce operational costs, have low risk, improved productivity, minimize the environmental impact of the facility, etc.

The EU provides several funding schemes to support energy saving measures in its member states. Among the most important are the European Structural and Investment Funds (ESIF) and the European Fund for Strategic Investments (EFSI). In addition, more specific financial instruments to support industrial energy efficiency will also be developed under **InvestEU**¹³. Such funds are usually streamlined through national and regional authorities and institutions.

Many EU member states have their own financing programs for energy efficiency and renewable energy projects, including those in industry.

White certificates (also known as Energy Efficiency Certificates or EECs) are relevant in some EU countries as a mechanism to incentivize and reward energy efficiency improvements in industry and other sectors. White certificates are tradable certificates that represent a certain amount of energy saved by implementing energy efficiency measures. By implementing energy efficiency measures and earning white certificates, businesses can receive a financial reward for their efforts. White certificate schemes are currently in place in several EU countries, including Italy, France and Belgium. However, the specifics of the schemes can vary between countries and can be subject to changes over time.

It is important to note that financing options and policies can vary between EU member states. Therefore, it is recommended to consult with industrial associations, energy experts,

¹³ https://investeu.europa.eu/index_en.

local authorities and financial institutions to determine the most suitable financing option for the company's specific needs and circumstances (the Annex of this strategy includes information on EU and National, local funding opportunities).

Some suggestions and general remarks about financing:

- Searching the open calls for subsidies for the investment projects and request the subsidy;
- Look for bank and other entities financing that are focused on energy efficiency and renewable energy installations for companies to reduce usual barriers that financial institutions have related to this project;
- Linked to the previous one, screen and select an adequate financing institutions, with experience and reliable;
- Choose the best option of financing for the specific investment project; i.e. renting or loan could be also suitable;
- Research financing before implement energy saving measure; in some funding programmes is necessary not to implement the ESM before fund request;
- Check carefully all necessary documents and data for getting funding;
- Carefully read the contract and clauses before signing, as the cancellation clauses, interest periodic renovation, etc.

The Annex includes information of the main EU and financing national programmes of the partner countries for the interested industries.

7. CAPACITY BUILDING

The capacity building on energy efficiency and renewable energy sources (i.e. ESM) shall be targeted to several groups inside companies (different staff positions) as well as to external groups, such as industrial associations and other intermediaries, energy experts, etc. These groups include mainly:

- Managerial staff – high level managers and decision makers;
- Operational staff – energy managers and technicians;
- Industry association and other multipliers.

a) Managerial staff

In case of managerial staff, **expected general skills** to promote the ESM implementation involve:

- Definition of a clear strategy and plan of investments in relation to energy savings;
- Regularly information on the energy consumption of the company and related energy costs;
- Knowing the general state of the company's technology and buildings in terms of energy consumption;
- Being informed of the latest trends, opportunities and good practices in energy-related aspects;
- Knowing at general level financing options for ESM from various sources;
- Costs of employees who oversee the company's energy efficiency;
- Being aware of the benefits of ESM already in place their payback period and the status of implementation of the ESM proposed in the energy audit and briefly know the other existing ESM to improve the energy performance of the company.

Although companies' managers should receive basic energy and technical information, there are more important topics to be communicated to them. Relevant data should be presented from economic point of view (investment, savings, funding/financing possibilities), emphasizing also other multiple benefits, such as policy and regulatory aspects (carbon footprint reduction, non-financial reporting), quality and environmental aspects, marketing aspects (image of the measure, PR/communication), etc. From this perspective, relevant topics and fields of interaction in relation to ESM implementation should include:

- The latest trends, opportunities and good practices in energy-related aspects of business with specific focus on relevant industry;
- The most often ESM implemented in relevant industry sector;
- The regulatory obligation relating with relevant industry sector;
- energy management system benefits;
- Jointly with managerial staff, to identify actual energy costs of the company, its division, the ratio of energy costs to other costs, the costs dedicated to employ the energy staff (energy manager, technician), the investment costs to ESM implemented in previous years;
- Jointly with managerial staff, to identify optimum solutions for their specific situation (ex. try to identify together the energy savings potential in their company) analysing

the existing energy audit ESM and explanation of the effect of ESM already implemented;

- How to facilitate the development of strategies and/or plans supporting the ESM implementation and general steps leading to implementation of that ESM from energy audit which has not been implemented yet (to introduce the expected savings in MWh, EUR, financing options for ESM implementation, payback period, etc.).

The A2M project will train the company's management with bilateral meetings organized for each company separately in 5 project partners countries. Altogether 10 bi-lateral meetings – workshops – between the respective project partner and the company with approximate duration of 1-3 hours in each country will be managed. The participants will be the highest-level management including financing, legal (and CSR) management representatives. The form of the workshop can vary (breakfast, coffee roundtable, etc.), it depends if it is organized in the company or at another relevant place. The conclusions and recommendations will be summarized and presented to the company in a form of a short report or presentation.

b) Operational staff

For operational staff that includes companies' energy managers and technicians, knowledge on technical issues (ESM, technical solutions, energy savings, etc.) and its benefits complemented by economic, regulatory and environmental aspects represent the expected general skills to promote the ESM implementation. Particular topics relevant to ESM implementation include:

- ESM and RES implementation and technical solution related to technology processes and their benefits in industry;
- Organizational measures and good practices leading to energy savings related technology processes and operations;
- Monitoring and analysing the energy consumption;
- Funding/financing opportunities for ESM;
- Regulatory obligation related to ESM implementation;
- Carbon footprint and neutrality;
- Energy management system opportunities.

The project will offer a blended learning programme for operational staff consisting of a training course (a half-day in-person training (workshop)) for representatives of involved companies (minimum 20 participants) in each country and e-learning programme (40 hours) with participants' registration and certification of completion. The training materials of e-learning will consist of texts, documents, presentations, videos and case studies.

As an additional program for this stakeholder group might be useful a technical visit of companies where ESM or latest energy efficiency technology has been implemented.

c) Industry association and other multipliers

External stakeholders to be addressed involve industry associations (and their member organizations), industry energy-related experts, business/commercial experts, economists, managing authorities and other professionals working on (or closely related with) industrial

energy efficiency. The following general skills to promote the ESM implementation are expected:

- Latest trends, opportunities and good practices in energy-related aspects;
- Regulation related to ESM and energy audits in industry;
- Most often barriers for ESM implementation in industry and how to cross them.

In order to be able to detect, propose and promote the implementation of ESM, the important topics in relation to this group include:

- The latest trends, opportunities and good practices in energy-related aspects of business with specific focus on industry;
- The existing and expected regulatory obligation (EU, local) relating with relevant industry sector;
- How to facilitate the development of strategies and/or plans supporting the ESM implementation and general steps leading to implementation of that ESM.

Project partners will organize two training workshops (2.5 hours) at the industry associations' and multipliers premises (minimum 20 participants per workshop) per country. Part of each workshop will be reserved to networking focused on information and experience exchange between the stakeholders.

8. GETTING SUPPORT FOR IMPLEMENTATION OF ESM

At the core of the project is the provision of support to specific industry companies by partners struggling to implement the ESM identified through an energy audit or similar which often require dedication and resources from multiple departments and typically support from external experts.

General staff might lack time or the specific knowledge on energy efficiency measures needed and therefore how to use the services from energy auditors and other external service providers to have the right information to take a decision on whether to implement an ESM or not.

As stated before, typical barriers preventing a broad implementation of ESM are about technical, economic-financial, regulatory-legal and behavioural-soft. To help overcome these barriers the project specifically addresses them with related activities:

A) Technical support

Addressing the lack of specific information and knowledge on some potential energy efficiency measures, new technologies or equipment more efficient or lack of capacity to measure certain parameters (energy, CO₂, heat loss, etc.) needed to assess the ESM.

- Receive information and explanation from energy experts, equipment manufacturers, or others, about the specific ESM detected, making use of brochures, videos, face to face or video meetings, in addition to the information prepared as part of A2M (KPIs, ESM sheets, etc.);
- Getting advice on how to measure and/or calculate the achieved energy efficiency savings by the implemented measure versus the current situation;
- Capacity building (as tailored training courses), provided by the energy experts, equipment manufacturer or installers. It could be in the own industry, in a specific venue, online, or even at the premises of a manufacturer;
- Get in contact with other users' cases that have applied a specific ESM, to identify and clarify issues on it, as prevent common pitfalls through knowledge exchange. It could include a meeting or visit. (This is a general suggestion).

B) Economic-financial support

Generally, there is lack of knowledge on how to estimate the investment costs and calculation of the economic results of ESM, as well as existing funding options.

- Receive information and explanation by experts about the investment needed and how to calculate the economic viability making use of brochures, videos, face to face or video meetings, in addition to the information prepared as part of A2M (KPIs, ESM sheets, etc.);
- Getting advice on the costs (CAPEX and OPEX) of the ESM and receive support calculating the economic viability of the ESM. Receiving Assessment in prioritizing ESM according to economic results, considering difficulty of implementation;
- Receive advice on existing funding programmes and private financing options. This includes public funds, private financing, ESCOs and EPCs (Reference in chapter 6).

C) Regulatory and legal support

There is a support need to help and understand the regulatory and legal obligations linked to the ESM.

- Getting general information by energy experts about the regulation and laws affecting ESM that are under assessment;
- Getting advice and explanation by energy experts about the specific regulation and laws affecting ESM;
- In critical issues or which need very specialized advice, industries should receive contact of legal energy experts;
- Receive a first steering overview of the present policy framework in the participating country as a general first step.

D) Behavioural and Cultural change

The concept of energy culture¹⁴ was introduced as an interdisciplinary concept, which combines behavioural, technical and cultural perspectives. Energy cultural changes include as main topic energy behaviour variations; how to improve energy behaviour as they are complex and shaped many elements as contexts, feedback or motivation should help. Indeed, behaviours are driven by social, cultural and educational aspects that affect energy consumption and define the energy culture in the end.

- Getting general information from experts about what is energy cultural change and the more current mistakes on the energy behaviour in industries relating this aspect;
- Receive advice on the specific information of the potential changes of energy behaviour and how to achieve them (event in the place of the industry, brochure-poster with indicative tips for the change, leaflets for the workers, etc.);
- Specific requirements for changing behaviour may arise, for example through the reluctance towards a new machine or new system and therefore it is important to get a steering coaching on the benefits of using the new measure and may need some changes by the workers.

To help differentiate the main people, companies, associations and other private and public bodies who can provide steering support in this process the following list is provided:

- Energy experts and auditors;
- Business associations;
- Technological centres and universities;
- Manufacturers/retail, association/s of equipment/s (national and European associations of pumps, lighting, motors, etc);
- Financing institutions, banks and other private financing bodies (programmes for industries mainly as loans or TPF);
- ESCOs (Energy services companies offer technical and financial support for ESM);
- Energy legal experts or companies;
- National local authorities (National energy agencies provide information and financing support with specific programmes of soft loans for specific ESM);

¹⁴ "Towards sustainable energy culture in the industrial sector", Virpi Oksman, Energy Sustainable and Society 2021.

- Others.

Table 4 includes the main support providers and the type of support they usually provide.

Table 4: Providers and type of support to implement ESM.

Provide support:	Technical support	Economic -financial support	Regulatory-legal support	Behavioural -cultural change
Energy experts and auditors	X	Only information	X	X
Business associations	X	Information and financing if ESCO association		X
Technological centres and universities	X	Sometimes information		
Manufacturers/retail, installers and their associations	X	Sometimes		
Financing institutions, banks, other private financing		X		
Energy Services Companies, ESCOs	X	X	X	
Energy legal experts or companies			X	
National and local authorities	X	X		

Experience(s) has learned that the implementation of ESM, especially in critical processes within industry, is never as straightforward as they set out to be and often encompasses a multitude of internal and external factors that need to be addressed. By breaking down these factors into typical barriers and describing the fitting support mechanisms offered by the A2M project team solutions should more easily be found and barriers be overcome.

The Knowledge Exchange Space

As part of the project's ambition to promote the application of best practices surrounding ESM implementation exchanges between industry companies and related stakeholders are facilitated through the creation of a secured KES. Such a space allows industry players to share their knowledge, experiences, findings and ideas on ESM which should result in a more efficient use of their time and resources and lead to significant energy savings in the end.

The KES fosters collaboration and general networking/discussion among (national) industry players, also involving policy developers and/or research institutes at the national and international level. By facilitating this exchange, it should allow them to learn from each other's successes and failures through sharing of experiences, companies and policymakers are supported in identifying best practices and solutions that are tailored to their specific needs and challenges and are proven to work.

Moreover, the KES is intended to act as a platform for the dissemination of information, including the latest research, reports, case studies and the KPI database of implemented ESM. By having access to up-to-date information, companies can make informed decisions about implementing ESM in their operations and can have informed, moderated discussions with experts closely related to the topic through the facilitation provided by the project consortium and its extended network.

When combined and executed well and taken up by stakeholders these factors can be a valuable resource for companies that are just starting on their ESM journey, but also veterans in the field. By providing access to the knowledge and expertise of more experienced players, new entrants can avoid common pitfalls and accelerate their progress towards energy efficiency by identifying the most appropriate and convenient solution for their specific case. The lessons drawn from these exchanges can be particularly beneficial for small and medium-sized enterprises (SMEs) who may not have the same resources and expertise as larger companies and feed into the development of future policy measures.

In practice the KES will have a public and a non-public side to it (Figure 9). The public side will be hosted on the A2M website and supports the dissemination of information and interactive discussions coming out of the non-public side of the platform which is a secured environment (MS Teams channels) accessible only to selected parties and moderated by the project consortium members, to have the more sensitive discussions on information that is confidential to the wider public like the detailed results of the energy audit reports.

The project consortium will actively promote the uptake of both sides of the KES and a series of online dialogue events as well as other workshops are planned that will draw people to the ongoing discussions on the KES.

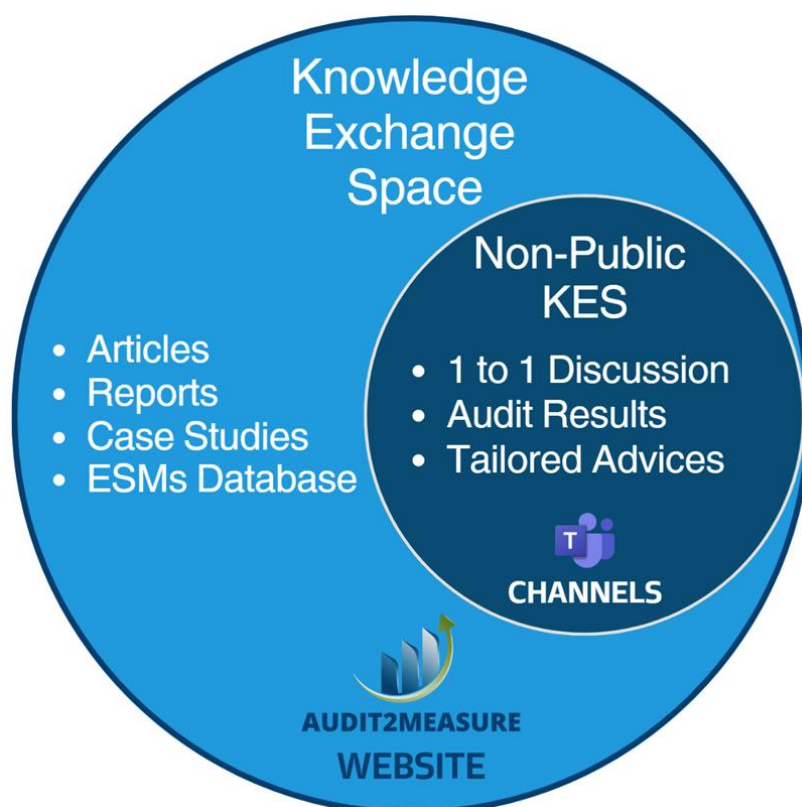


Figure 9: Architecture of the Knowledge Exchange Space (KES).

9. ASSESSMENT OF COMPANY ABOUT EMS AND ISO 50001

An EnMS is a systematic approach to manage an organization's energy consumption and for lowering energy costs. EnMS provides a framework for developing, implementing, maintaining and enhancing energy performance, as well as integrating energy management into overall company processes. It is described as an organization's interrelated or interacting elements, such as policy, objectives, energy targets, energy baselines, energy performance indicators, internal audits, procurement processes and design.

ISO 50001 is a global standard which outlines the requirements for building, implementing, maintaining and upgrading an EnMS. The International Organization for Standardization defines an EnMS as a system whose purpose is to enable an organization to follow a systematic approach to continually improve energy performance, including energy efficiency, energy use and consumption. 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 different types of organizations, regardless of size, sector or location.

The maturity models for energy management and ISO 50001 processes are related but are different regarding their scope and focus. Energy management maturity models provide a framework for improving energy management practices across an organization, whereas ISO 50001 focuses on the processes and practices associated with the EnMS and improving energy performance in a systematic manner.

Since energy audits reveal possible energy-saving opportunities, ISO 50001 provides a framework for transforming those opportunities into actions, thus ensuring long-term energy performance improvement. Industries, using EnMS, can track progress towards energy targets, identify areas for improvement and take corrective actions as needed.

To begin implementing an EnMS, an industrial company should form an energy team, conduct an energy review, create an energy policy, establish energy objectives and targets, regularly monitor and measure energy performance and continuously review and improve the EnMS. These measures can aid the industrial companies in conserving energy, reducing expenses and enhancing their environmental performance.

To this end, the A2M strategy provides a guide in the form of a maturity model according to which a company can assess its position in the implementation of the PDCA cycle of their energy management activities. With the A2M EMS maturity questionnaire, each company's current energy management practices are evaluated against the requirements of the standard in each of the following areas, over time:

1. Energy policy and objectives: The company's energy policy should be aligned with the requirements of ISO 50001 and energy objectives should be established that are measurable and consistent with the company's energy policy;
2. 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;
3. Energy review: The company should conduct regular energy reviews to identify energy-saving opportunities, assess energy performance and monitor progress toward energy objectives;

4. Energy performance indicators (EnPIs): The company should have established EnPIs that measure energy performance and enable monitoring of progress towards energy objectives;
5. Energy management system (EnMS) documentation: The company should have documented policies, procedures and records demonstrating compliance with ISO 50001 requirements;
6. Management responsibility: Senior management should demonstrate leadership and commitment to the EnMS, including providing resources and meeting energy objectives;
7. 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;
8. Performance evaluation: The company should regularly evaluate the effectiveness of its EnMS and take corrective action, as necessary.

The output of the questionnaire maps the company's energy management maturity status and provides concrete guidance for the following:

- I. Structure and enhance the understanding of energy management practices;
- II. Provide an understanding of the steps required for successful energy management;
- III. Provide a roadmap towards continuous improvement;
- IV. Enable benchmarking of the current energy practices against other organizations as all the ISO50001 processes and PDCA phases will be incorporated into the project's Knowledge Base;
- V. Adoption towards certification process.

The maturity model uses five levels of increasing maturity based on the scoring for each ISO 50001 requirement identified in the standard, reflecting the company's readiness or maturity stage towards complete compliance with the respective requirements, while providing information on identifying specific energy management activities that may require improvement. An overall maturity score is calculated as the average of the score across all standards' requirements.

ANNEX

EU FUNDING PROGRAMMES

There exist various EU funding programmes that mobilize public and private investments that contribute to reaching EU's energy efficiency and climate objectives. They support energy efficiency projects and initiatives, from idea to implementation, by financing legal, technical and financial support. At the same time, companies can make use of other existing financial products and schemes that are available on the market.

Table 5: Financing options.

EU funding programmes	Private financing schemes
EU co-funded programmes	Bank loans and guarantees
Financial instruments	Green bonds
Research and innovation programmes	

EU CO-FUNDED PROGRAMMES

EU funding programmes ensure direct co-financing of investments in energy efficiency and RES projects. They also support research, innovation and technology development and capacity building of private and public entities.

Recovery and Resilience Facility

This instrument is the main source of public funding for energy efficiency in the coming years. It focuses on public buildings and residential buildings as well as on industry decarbonisation. Access to the Facility is based on National Plans drawn up and submitted by Member States.

Cohesion policy funds

These include the European Regional Development Fund, the European Social Fund Plus, the Cohesion Fund, the Just Transition Fund and INTERREG. These funds are a key source of funding for direct investments in energy efficiency. The **Cohesion Fund** supports investments in the field of environment for example by reducing greenhouse gas emissions, increasing the use of renewable energy or improving energy efficiency. It provides support to Member States with a gross national income (GNI) per capita below 90% EU-27 average¹⁵.

The European **Regional Development Fund** (ERDF) aims to strengthen economic, social and territorial cohesion in the European Union by correcting imbalances between its regions. In 2021-2027 period, the fund supports also investments to make Europe and its regions 'greener, low-carbon and resilient'.

Just Transition Mechanism

The Just Transition Mechanism has been proposed as part of the European Green Deal investment plan. Its primary goal is to provide support to the most negatively affected regions (e.g., coal-intensive regions). The mechanism contributes to a wide range of measures; however, the actions depend on the circumstances of the given territory.

Modernisation Fund

This fund was established under the Emissions Trading Scheme Directive with the total budget of around €14 billion available to 10 lower-income EU countries¹⁶ to support

¹⁵ For the 2021-2027 period, the Cohesion Fund concerns Bulgaria, Czechia, Estonia, Greece, Croatia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Portugal, Romania, Slovakia and Slovenia.

¹⁶ Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia.

investments in the modernisation of their energy systems and energy efficiency improvements. With the goal to speed up the transition to a climate neutral society, the fund targets investments in renewable energy, energy efficiency, energy storage, energy networks and just transition in carbon-dependent regions.

FINANCIAL INSTRUMENTS

The EU provides loans to businesses of all types for investment in research and innovation. It also provides guarantees to help beneficiaries to obtain loans more easily or at better conditions from banks and other lenders. The EU may also financially participate in a project by owning parts of it. Financial instruments can also be combined with grants.

Financial instruments are implemented in partnership with public and private institutions such as banks, venture capitalists or angel investors. These financial institutions determine the exact financing conditions – the amount, duration, interest rates and fees.

Funding under partnership with the European Investment Bank

The European Investment Bank (EIB) helps finance energy projects by providing companies with loans and other financial instruments including guarantees, equity investments and advisory services. The EIB Group is also in charge of implementing 75% of the **InvestEU** programme, which aims to mobilise public and private financing for strategic investments to support EU internal policies (incl. energy efficiency).

ELENA – European Local Energy Assistance

ELENA provides technical assistance for energy efficiency and renewable energy investments targeting buildings and innovative urban transport. Eligible activities include:

- technical studies, energy audits, business plans and financial advisory;
- legal advice, tendering procedure preparation, project management.

PRIVATE FINANCING SCHEMES

Private funding is an option for business owners that allows them to grow their enterprises. It encompasses many types of funding, including bank loans, guarantees, investments from individuals on crowdfunding sites, Energy Performance Contracting, etc.

BANK LOANS AND GUARANTEES

Bank loans provide a smart source of financing to developed businesses and allow for extended repayment over time with predictable fixed monthly payments. An investor may ask for a bank loan from a national (commercial) bank or an international bank, such as European Investment Bank or European Bank for Reconstruction and Development. A bank loan may allow companies to finance energy-saving investment projects. **Bank guarantees** make it easier for entrepreneurs to access investment loans from commercial banks and small businesses to secure e.g., operating loans. A bank guarantee is a promise by a lending institution to cover a loss if a business transaction doesn't unfold as planned.

GREEN BONDS

Green bonds provide a means for businesses to raise capital for their investment projects by issuing debt instruments that are specifically earmarked for environmentally friendly initiatives. These bonds are designed to finance projects with clear environmental benefits, such as renewable energy, energy efficiency, clean transportation and pollution reduction.

By attracting environmentally conscious investors, green bonds can help enterprises secure the necessary funding for these projects at competitive interest rates.

NATIONAL FINANCING FOR ESM OF INDUSTRIES

GREECE

The National Strategic Reference Framework (NSRF) 2021–2027 promotes the green transition of small and medium-sized enterprises (SMEs) through the incorporation of modern digital technologies, infrastructures, best practices in energy upgrading and the use of renewable energy sources. It consists of two separate actions:

- Action 1: "Green Transformation of SMEs";
- Action 2: "Green SME Productive Investment".

The [National Bank of Greece](#) strengthens financing for the purchase of mechanical equipment and covers the costs of constructing a photovoltaic plant and other RES (Renewable Energy Sources) with up to 80% of the total investment cost and up to one million euros per customer. In addition, [Piraeus Bank](#) facilitates the green transition of Greek SMEs through green financing programs, such as long-term loans for investments in photovoltaic systems and loans to cover the costs of replacing or renewing the PV station's fixed equipment in order to boost its productivity. In addition, loans for financing RES investment initiatives are available as part of the NSRF (ESPA) programs and/or other subsidized programs.

In addition, the state funded "[EKSOIKONOMW/EPIXEIRO](#)" program has been incorporated into the Greece 2.0 initiative with a budget of 450 million euros from the Recovery and Resilience Fund (RRF). The program's objective is to increase the energy efficiency of small and medium-sized businesses, resulting in at least a 30% reduction in energy costs. Businesses can self-consume energy by investing in photovoltaic panels coupled with batteries for excess energy storage. The eligible financing relates to energy efficiency renovations in the tertiary and secondary sectors, installation of energy-efficient equipment (e.g., equipment and systems for the production of hot water/steam, waste heat recovery equipment), energy upgrades of buildings and production processes (e.g., upgrade of lighting systems, internal electrical installations), replacement of old A/C units with upgraded heating and cooling systems and photovoltaics on the rooftops of businesses.

ITALY

The incentives for energy efficiency in Italy are different and vary depending on the type of intervention carried out and the subject who performs it. The main ones are including White Certificates, the Thermal Account and tax deductions.

White Certificates (Certificati Bianchi) are the most important tools for promoting energy efficiency in companies and public administration. These are negotiable securities that are provided based on savings in final energy uses achieved through efficiency measures. A wide variety of technologies are included both for electrical a thermal use.

The **Thermal Account (Conto Termico)** is another tool with which energy efficiency is incentivized and which is aimed at public administrations, companies and individuals. The Thermal Account promotes energy efficiency solutions and renewable sources for thermal energy generation through direct cash flow.

A wide variety of **Tax deductions** for energy efficiency are available and are applied to expenses incurred for interventions that increase the level of energy efficiency of existing buildings. Taxpayers can deduct part of the expenses incurred for the works from personal income tax or corporate income tax. Companies can also benefit from **tax credits** for development interventions and technological innovation associated to energy efficiency, in the context of **Industry 4.0 (Piano Nazionale Industria 4.0 and following updated versions)**, a national program supporting the technological and digital transformation of industries.

“Fondo nazionale efficienza energetica” is an allocated fund aimed at providing either warranties for loans or subsidized loans addressed to the support of energy efficiency interventions.

CZECH REPUBLIC

In the Czech Republic, a number of subsidy titles funded by various programmes can be used to finance energy efficiency and RES, in particular:

- Structural Funds: Operational Programme Technologies and Applications for Competitiveness and Operational Programme Environment;
- Modernisation Fund: ENER G Programme, ENER G ETS, RES+, TransCom;
- The Recovery and Resilience Facility;
- National Recovery Plan: these are subsidised energy-saving measures for businesses include investments in renewable energy equipment, insulation of buildings and replacement of heating and air-conditioning systems, lighting and upgrading production technologies by replacing energy inefficient machinery;
- The Operational Programme Technology and Applications for Competitiveness: this is the main programme for businesses aimed at supporting measures contributing to the reduction of energy intensity of the business sector. In concrete terms, this includes the renewal of production technology in the form of replacement of energy inefficient machinery, lighting of buildings and their insulation, modernisation and reconstruction of distribution systems, installation of equipment for the use of renewable energy sources or, for example, the introduction and modernisation of metering systems;
- The Modernisation Fund, which aims to reduce greenhouse gas emissions, modernise energy systems, improve energy efficiency and increase the share of renewable energy sources in the final energy consumption of installations covered by the EU ETS;
- The ENER G programme, which provides business loans to companies in the manufacturing and construction, retail and wholesale, transport and storage, tourism, agriculture and energy sectors. It can be used for the insulation of buildings, the replacement of heating and air conditioning systems, lighting or, for example, the installation of a renewable energy plant;
- ENER G ETS, which aims to support equipment and measures to improve energy efficiency and/or reduce greenhouse gas emissions in industrial production for installations included in the EU ETS;
- RES+ (New Renewable Energy Sources), which supports new non-fossil renewable energy sources (mainly PV, hydrogen applications, etc.);

- TRANSCoM - Modernisation of transport in the business sector: the programme supports the purchase and acquisition of alternative fuel vehicles and non-public infrastructure by business entities;
- The Operational Programme Just Transition, which primarily aims to mitigate the socio-economic impacts of the green transformation within the Karlovy Vary, Moravian-Silesian and Ústí nad Labem Regions. Although the promotion of energy efficiency is not the main objective of the programme, the programme funds can be used for these purposes. Specifically, the programme supports investments in renewable energy installations or the reconstruction and modernisation of district heating networks, as well as investments in heat production based exclusively on renewable energy sources. The Operational Programme Environment is primarily focused on investment support for reducing the energy consumption of public buildings and infrastructure. Businesses can also benefit from the programme, particularly in the transition to a resource-efficient circular economy.

Businesses can also benefit from relevant components of the **National Renewal Plan**, in particular in the use and accumulation of renewable energy sources, the transition from fossil fuels to emission-free sources, reducing energy consumption, improving energy efficiency, building waste and recycling infrastructure.

NETHERLANDS

The Dutch government has implemented a range of policy measures, subsidies and regulation to go with it promoting financing of energy-saving measures in industries. The EIA, MIA and VAMIL schemes are among the most important measures that offer companies tax advantages and financial benefits while the SDE++ and VEKI offer government subsidies. There are also formal agreements made between government and the industry sector which are primarily covered by the Green Deals and Energy Saving Agreements for industry.

Tax incentives:

Energy Investment Allowance (EIA): The EIA is a tax scheme that provides companies with tax relief for investments in energy-efficient equipment. Companies can deduct a certain percentage of the investment costs from their taxable profits.

Environmental Investment Allowance (MIA): Offers companies tax advantages for investments in environmentally friendly products, including ESM.

Depreciation of Energy-Saving Investments (VAMIL): Offers companies the opportunity to depreciate up to 75% of the investment costs of energy-saving measures. The depreciation can be spread over a period of five years, providing companies with a significant financial benefit.

The above incentives are only available for investments included in the annually revised [Energy list](#).

Subsidy:

Sustainable Energy Production Subsidy Scheme (SDE++): Offers companies a subsidy during the operating period of their sustainable energy project. The SDE++ subsidy aims to compensate for the difference between the cost price of the renewable energy or the

reduction in CO₂ emissions and the revenue (if any). This is referred to as the “unprofitable component”. Subsidies are allocated for periods of 12 or 15 years.

VEKI: Offers a subsidy to accelerate climate investments in Industry for tangible and intangible assets that contribute to cost-effectively reducing CO₂ emissions in the industry in the Netherlands by 2030. Projects must lead to an absolute decrease in CO₂ emissions in the Netherlands to be eligible and includes the (applications of) devices, systems, or techniques that have a payback period of more than 5 years without subsidy.

SPAIN

The National Energy Agency IDAE manages funding subsidy for improvement energy efficiency in SMEs; FEDER funds and it depends on the Region that the direct support can be from 15% of investment in Madrid and Cataluña, till 30% in Extremadura andalucía Castilla La Mancha, etc. The Regional Governments directly provide those funds available for different types of measures, some examples are here included:

- Castilla y León: the support for energy efficiency in the company can reach 30-50% of the investment depending on the province¹⁷; also, relevant information in the European Project SME Power ¹⁸.
- Madrid Region manages line for new business, transformation of the production process in PYMES¹⁹.
- Cataluña: energy efficiency measures minimum investment 30,000 Euro, all type of industries ²⁰.

Renewable incentives for industry of the PTR plan for Transformation and Resilience - Next Generation Funds; the [National Energy Agency](#) IDAE published the normative, open data of the calls since 2022 and general information. The regions governments manage these incentives and some examples are included:

- Madrid solar thermal installations [programme 1](#) for industries, agriculture, farming and residential sectors;
- Madrid self-consumption using renewable energy sources for productive sectors [programme 2](#).

Regional governments also manages some programs with resources of the European Agricultural Fund for Rural Development, [EAFRD](#)²¹ and some industries are getting financing for photovoltaics installations.

Some **private banks** also provide soft loans for specific projects of environmental or renewable energy sources as photovoltaics – (example Triodos Bank, BBVA...).

¹⁷ www.ayudasenergiaempresas-cyl.es

¹⁸ <https://energia.jcyl.es/web/es/eren-europa-otros-foros/proyecto-power.html>

¹⁹ <https://www.comunidad.madrid/etiquetas/ayudas-pymes>

²⁰ <https://fandit.es/subvenciones/detalles-subvencion/subvenciones-del-programa-de-actuaciones-de-eficiencia-energetica-en-pymes-y-grandes-empresas-del-sector-industrial>

²¹ https://agriculture.ec.europa.eu/common-agricultural-policy/rural-development_en