



AUDIT2MEASURE

D2.2 Top management decision process

A qualitative assessment of decision-making on energy efficiency investments in the manufacturing industry



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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 saving 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 will develop and implement a new engagement strategy (called "Audit2Action") to put into action the opportunities emerging from energy audits.

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PROJECT PARTNERS



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ABBREVIATIONS

EE	Energy Efficiency
EED	Energy Efficiency Directive of the European Union
EMAS	Eco-Management and Audit Scheme
EMS	Energy Management Systems
ESM	Energy Saving Measures
HVAC	Heating, ventilation and air conditioning
ISO	International Organization for Standardization
NEB	Non-Energy Benefits
SME	Short and Medium size Companies (EU definition)

INTRODUCTION

This report is the second deliverable of the baseline package WP2 of the AUDIT2MEASURE project. After the first report examined the state-of-the-art of European audit systems and ESM implementation in the project countries Czech Republic, Germany, Greece, Italy, the Netherlands and Spain, this report focuses on the implementation of energy saving measures (ESM) in industrial manufacturing companies. The main goal is to present insights on the top management mindset and decision-making process on energy efficiency investments in companies.

This was achieved through an in-depth survey of 31 industrial manufacturing companies carried out across five countries in the form of multiple-choice questionnaires. In order to corroborate findings, a complementary questionnaire also gathered information from 35 energy auditors. They are important stakeholders accompanying companies in their decision-making process and will play a key role in the upcoming project activities.

After describing the main characteristics of surveyed companies and assessing the gap between actual recommended and implemented ESM, the report investigates the mindset of surveyed companies regarding energy efficiency as well as the processes, actors and reasons behind a decision to invest or not in ESM. This assessment will be completed by a follow-up report which will further analyse and compare the questionnaire results with the literature on economic, technical, behavioural and structural barriers that affect the uptake of ESM in the manufacturing industries.

The results are of particular relevance as the European Commission is in the process of revising the EED. Understanding the point of view of the key stakeholders involved in the implementation of Article 8 of the EED is crucial to elaborate adequate policy recommendations as planned in WP7 of the AUDIT2MEASURE project.

1. METHODOLOGY

1.1. Survey process and structure

In order to assess the implementation of ESM following and related internal decision-making processes in industrial manufacturing companies (NACE Code C), qualitative surveys were carried out in the Czech Republic, Greece, Italy, the Netherlands and Spain. A total of 31 company surveys have been performed. In parallel, further 35 surveys were conducted among energy auditors¹. The AUDIT2MEASURE partners in the five countries contacted industrial companies and energy auditors in their respective countries for interview or written completion of the surveys.

First, companies were asked for general information such as location, industry sector including NACE code, company size in terms of number of employees, number of production sites and turnover. Another set of questions asked companies to self-assess the internal relevance of energy efficiency and climate change and their willingness to invest in both. A further set of questions related to the self-assessment of the companies on the internal relevance of energy efficiency and climate protection and on their willingness to invest in both areas. The two largest blocks of questions focused on the implementation of the ESM in the companies, factors leading to implementation and internal decision-making processes. Questions were asked about the ESM proposed in the audits and those actually implemented. Furthermore, questions have been presented about the reasons for ESM implementation and non-implementation, NEBs and the use of energy management systems. In addition, companies had to describe their internal decision-making process on energy management. The last block of questions dealt with barriers to ESM implementation.

In parallel, 35 qualitative surveys were conducted among auditors. The results from the auditors are used to complement the information provided by the companies. For this purpose, the auditors were asked for general information about themselves, about the sectors they audit and about the audit process from the decision to carry out an audit to the presentation of the audit results. An important block of questions dealt with the ESM recommended in the audit and the ESM actually implemented in the companies. For example, questions addressed most relevant ESM and their economic evaluation. Surveys also included questions on the reasons for not implementing ESM in the companies and on decision-making processes.

1.2. Limitations and potential biases

The pool of surveyed companies and auditors per country and by sector (NACE C) is very small (e.g. no more than 6 companies interviews and 10 auditor interviews per country) and was not selected to ensure representativeness and proportionality of the results. The survey therefore cannot be used for statistical assessments of the European manufacturing industry and should be approached as qualitative in-depth case studies of companies and energy auditors across Europe. Nevertheless, valuable insights can be drawn from their responses,

¹ This exceeds the AUDIT2MEASURE's initial target of 50 company and auditor surveys in total, i.e. 10 surveys per country.

particularly with regard to the implementation of the ESM and the related decision-making processes. The surveys were recorded and analysed anonymously.

Potential biases in the composition of the pool and the quality of the responses must be considered when assessing the results. The consortium partners carrying out the surveys did not follow any specific methodology for the selection of the companies and auditors to ensure representativeness of the sample. Respondents were often people or entities that were previously in touch with the consortium partners. It is worth noting that, especially among companies, a majority declined the interview invitations. Surveyed companies therefore might be more committed to energy efficiency than the average of manufacturing companies in Europe. In fact, the self-assessment of the companies on their awareness of climate change and energy efficiency and their related investments were mostly very positive. It is also possible that, despite the anonymity, respondents wanted to present their company rather positively in the context of a survey on energy efficiency. In addition, it is unclear whether the staff put in charge of responding to the questionnaires were the more knowledgeable on energy efficiency and sustainability matters (e.g. energy management staff, ESG officers, spokespersons, etc.) and to what extent the answers provided reflect the internal positions and discussions of the companies.

2. DESCRIPTION OF SURVEYED ENTERPRISES

2.1. General classification

Sectors

In selecting the surveyed companies, a particular care was taken to interview companies from the most energy-intensive industries in Europe such as the chemical and pharmaceutical sectors, the metal and non-metallic mineral sectors, as well as the machinery and plastics sectors. Companies from the metal sector made up the largest share of respondents, followed by companies from the machinery and the chemical and pharmaceutical industries. In addition, individual interviews were conducted with companies from the food processing and electrical equipment manufacturing sectors.

Number of employees

Almost half (15) of the companies are medium-sized with a number of employees below 250 but higher than 50. Two fifth (12) of the interviewed companies are large companies with more than 250 employees. Only a seventh of the sample (4) have a number of employees that is below 50 and are thus considered as small.

Turnover

About two fifth (13) of the companies fall into the “large” group with a turnover of more than 50 million euros per year. A similar proportion (12) belongs to the “medium-sized” group, whose turnover is less than 50 million euros per year but more than 10 million euros. A fifth (6) of the companies surveyed have an annual turnover of less than 10 million euros and belong to the category “small”, one of which is even less than 2 million euros per year.

Respondents should indicate whether their following answers refer to the whole company or only to a single production site. About two thirds (20) of the respondents gave answers about the whole company, while the other third (11) only referred to a single production site.

2.2. Energy management

Energy consumption

Of the respondents who referred to the whole company, only a seventh (3) have an average annual energy consumption of less than 500 MWh/a (42 toe/a). About a third (6) of them are in the range between 500 MWh/a (42 toe/a) and 5,000 MWh/a (429 toe/a) and about half (11) in the range between 5,000 MWh/a (429 toe/a) and 100,000 MWh/a (8,598 toe). The latter can be considered as highly energy consuming and would be regarded as energy intensive companies in the five surveyed countries.

Half of (5) of the respondents who referred to only one production site indicated an energy consumption of less than 500 MWh/a (42 toe/a). About a quarter (3) reported consumption between 500 and 5,000 MWh/a (429 toe/a) and another quarter (3) between 10,000 MWh/a (860 toe/a) and 100,000 MWh/a (8,598 toe/a).

About half (16) of surveyed companies have already carried out a mandatory energy audit, a sixth (5) carried out a voluntary one, while a third (10) have not conducted an audit until now.

Energy management systems

Only a quarter (8) of the companies surveyed reported using an EMS. A seventh (4) of these had an ISO 50001 certified EMS of which 2 have an EMAS certified EMS and 2 others use energy monitoring and energy consumption planning. None of these companies are small, neither in terms of number of employees nor annual turnover.

Internal energy management staff

The companies were asked if they employ special energy management staff. A fifth (6) of companies reported having an internal team which deals with energy management. None of the companies have a single full-time position dedicated to energy management, but about half (16) have a part-time internal energy manager also in charge of other tasks. Very few companies use an external energy manager or team. Another fifth (6) companies have no energy management staff at all. It is worth noting that almost all (11 out of 12) large companies (by number of employees) do have energy management staff, which is internal in most cases (10 out of 12).

More than half of the companies do not allocate a specific annual budget to energy management. The size of budgets varies between companies and there are no clear patterns in terms of company size or turnover.

Nevertheless, two thirds (21) companies reported that they have installed smart meters. They use them mainly to measure electricity and gas. Some companies also measure heat and cooling energy. A few also report measuring water consumption with smart meters. When EMS were reported, they all covered at least 75% of the monitored energy carriers.

3. ASSESSMENT OF THE IMPLEMENTATION GAP

This section of the study focuses on the implementation gap between the ESM recommended in the audits and the ESM actually implemented in the companies. It also highlights the non-energy benefits (NEBs) mentioned in the audits. These are benefits that result from ESM but are not directly related to energy, such as an improved working environment. It also highlights the reasons given by companies for implementing ESM, which in turn influence the decision-making process. These are discussed in more detail in the next chapter.

3.1. Recommendation of ESM

3.1.1. Most recommended measures

The most proposed ESMs are in area of lighting. Two thirds (21) of the companies surveyed were advised to implement an EMS in this area. This is followed by process improvement measures, process heat and cooling, heating, ventilation and air conditioning (HVAC) and power generation. These areas of intervention were recommended in the range between two fifths and half of surveyed companies. Figure 1 shows how many of the surveyed companies were recommended ESM in a given area.

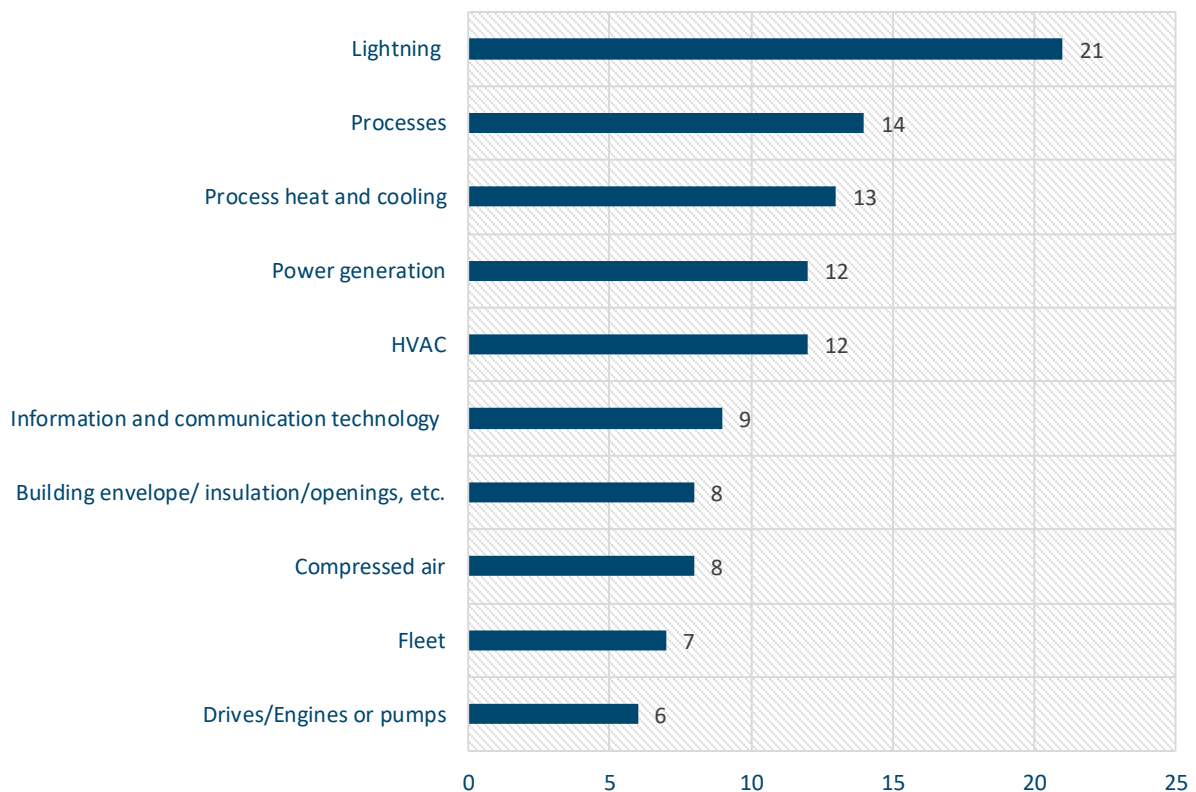


Figure 1: Recommended ESM (categories) in 31 surveyed companies.

In addition, the survey asked auditors about the most relevant ESMs in terms of energy savings and cost savings that they suggest in their audits. Figure 2 shows a similar distribution as Figure 1, although the distribution is more even than in the company survey. Lighting (21) and HVAC (20) were ranked as the most relevant. This is followed by process heat and cooling (17), compressed air (15), power generation (15), drives/motors or pumps

(15) and information and communication technology (15). The least mentioned ESMs are those applied to vehicle fleets, which can be explained by the fact that not every industrial company has its own fleet.

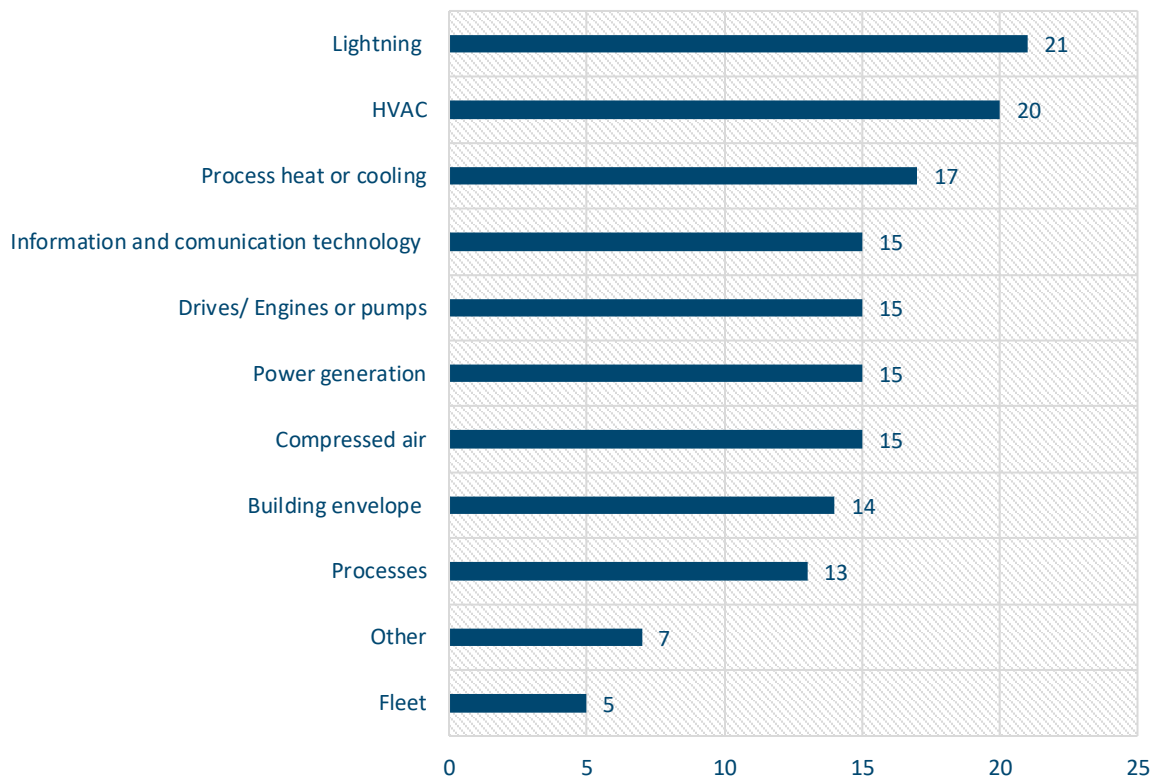


Figure 2: Most relevant categories of ESM according to 35 surveyed energy auditors.

3.1.2. Economic assessment of ESM

In order to highlight the economic benefits of ESM, energy auditors most include an assessment and ranking of suggested measures based on financial metrics in their audit reports. These indicators are an important component of the decision-making process by enabling the identification of relevant viable measures and providing a factual basis for the development of an investment plan that would lead up to ESM implementation. Energy audit norms such as EN 16247 and ISO 50002 however do not specify which financial metrics to use. National laws and guidelines usually further specify which metrics are required in the context of mandatory energy audits (see Table 1).

Figure 3 shows which metrics were most frequently used by the 35 interviewed energy auditors across the five considered countries. The internal rate of return (IRR) and the net present value (NPV) were the most cited metrics, outranking the simple payback period (SPP) calculation. IRR and NPV help compare investment scenarios and account for the time value of money, they provide more accurate and practical information as compared to SPP and can, therefore, ease decision making. SPP, IRR and NPV are compulsory or recommended metrics for mandatory energy audits in Czech Republic, Italy and Spain. Life-cycle cost (LCC) assessments and total cost of ownership (TCO) calculation were more rarely cited.

Table 1: Obligatory (O) and recommended (R) economic impact indicators in mandatory energy audits by country (Source: AUDIT2MEASURE D2.1 Status of National Audit Systems).

	CZ	GR	IT	NL	ES
Simple Payback Period (SPP)	O		O		O
Return on Investment (ROI)				O	
Internal Rate of Return (IRR)	O		O		R
Net present value (NPV)	O		O		R
Net present value on investment ratio (NPV/I)			O		
Life Cycle Cost (LCC)		R			

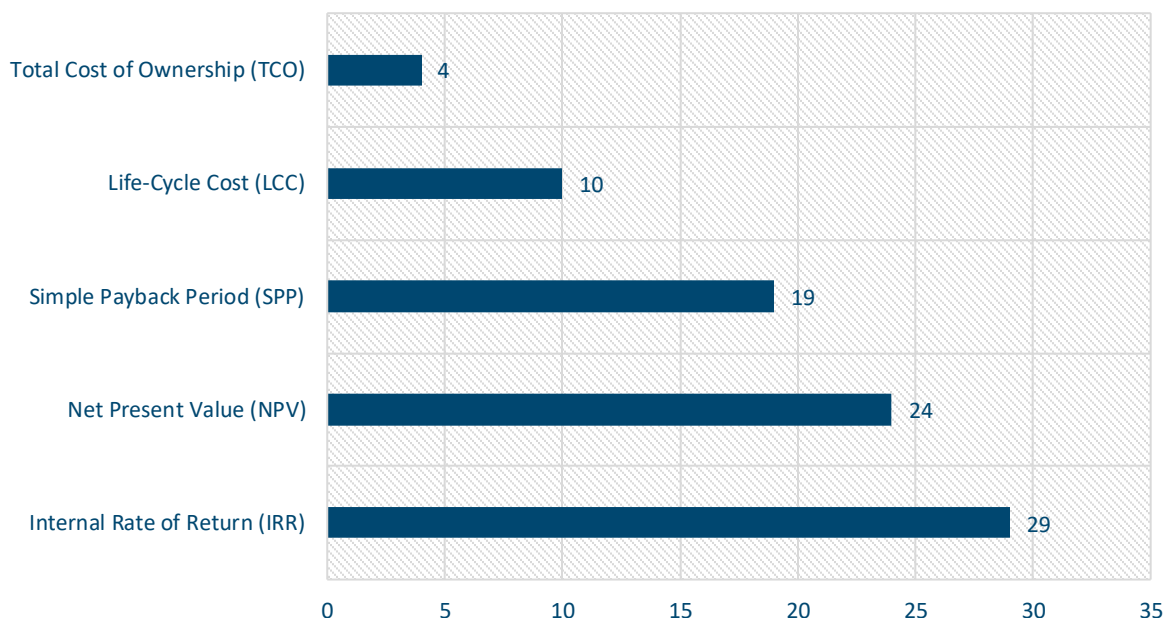


Figure 3: Use of economic performance indicators for ESM recommendations according to 35 surveyed energy auditors.

In Czech Republic, only IRR and NPV were mentioned by energy auditors. This matches Czech legal requirements for ESM assessments in energy audits. In Greece, IRR and LCC were used by almost all interviewed auditors. LCC is, in fact, strongly recommended by Greek law for ESM assessments, while IRR is not explicitly expected. In Italy, SPP, IRR and NPV are applied by most interviewed experts, this is in line with Italian law, while LCC was not mentioned a single time. In the Netherlands, auditors said they especially use NPV, while LCC was not mentioned at all. All Spanish auditors reported using either SPP or IRR or both when interviewed, which is conform to national recommendations.

Across all countries, national requirements and guidelines appear to have a significant impact on the thoroughness and consistency of economic assessments of ESM in audit reports. This highlights the importance of these legal frameworks in supporting positive decision making towards energy efficiency in manufacturing companies.

3.1.3. Non-energy benefits

NEBs can also influence the decision to invest in an ESM. They are therefore increasingly being considered by auditors in energy audits. Companies that include a sustainability strategy in their corporate objectives can, for example, gain a higher public profile by promoting the measures they have implemented.

Of the 21 companies that carried out a mandatory or voluntary energy audit, two thirds (14) reported that NEBs were mentioned in their audit reports and less than a quarter (7) reported that they were not. The most frequently mentioned NEB was carbon footprint reduction or climate change mitigation. This was followed by improved health and safety conditions, improved working environment, improvement of ESG indicators as well as environment and resources protection, such as reduced waste and water consumption, security of supply and self-sufficiency. Other NEBs such as improved product quality, increased productivity and low maintenance were less frequently mentioned.

Of the 35 auditors, only three fifth (21) reported mentioning NEBs in their audit reports. Similar to the company survey, reducing carbon footprint or mitigating climate change is the most frequently mentioned NEB. In general, the auditors' statements on NEB are in line with those of the companies. The exception is "reducing maintenance", which was selected much more frequently by auditors than by companies.

The comparison shows that companies have a good general awareness of the environmental, health and safety benefits of energy saving measures; while awareness of ESM's contribution to reducing hidden costs of companies could be improved.

3.1.4. Typical characteristics of suggested ESM

Auditors and companies were invited to name 3 exemplary suggested ESM from their last audits and to describe their key characteristics. These questions led to a list of 37 exemplary ESM from companies and 63 exemplary ESM from auditors. The most cited examples of measures both by interviewed companies and interviewed energy auditors are in the area of lighting, photovoltaic energy production, building and systems insulation as well as process heat, including heat recovery, representing about two thirds of mentioned measures. This is approximately in line with previously listed most frequently recommended measures by energy auditors.

The indicated investment costs vary widely between 1,000 EUR and 10,000,000 EUR, depending on the size of the considered plant or company and typology of measure. The mean investment cost cited by companies is close to 1,000,000 EUR while it is about 30% lower on the auditors' side, at around 6,400,000 EUR. Generally, the indicated energy saving potential for the ESM lies between 5% and 60% of the energy consumption it applies to. The related CO₂ savings potential lies in the same range. There are no major discrepancies in the exemplary ranges of impact cited by companies and by auditors.

The simple payback periods (SPP) of exemplary measures according to companies range from less than a year to 8 years. The SPP of exemplary measures according to auditors represented a wider range, from a few months up to 35 years, however, with only few measures exceeding 10 years. In both cases, the median value of exemplary SPP is similar, at about 5 years.

3.2. Implementation of ESM

3.2.1. Most implemented measures

Following the self-assessment, companies were asked about the implementation of ESM. They were asked in which areas the ESM had been implemented. In particular, they were asked about the same areas of action that had already been asked about in the questions on suggested ESM, in order to enable comparisons.

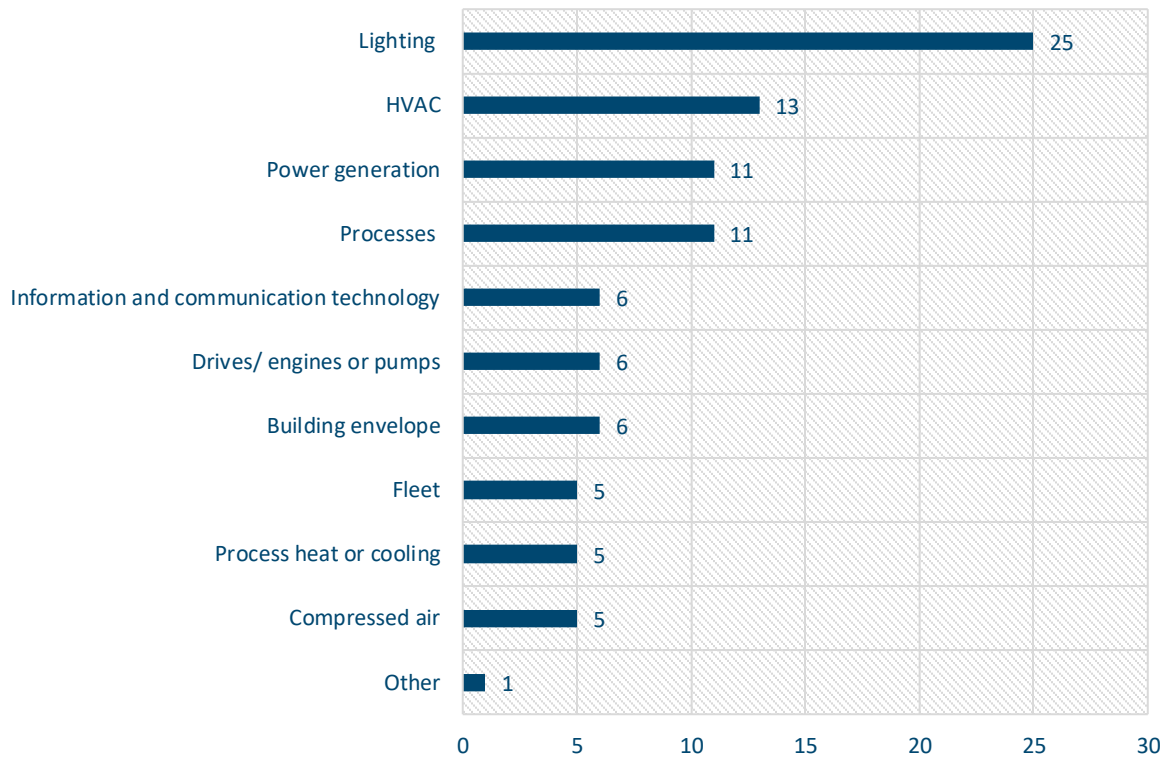


Figure 4: Implemented ESM (categories) in 31 surveyed companies.

As shown in Figure 4, companies have so far mainly implemented measures in the area of lighting. Lighting measures tend to be low barrier and low cost to implement than most other measures, which may explain why they are often preferred by companies (see 3.2.2. Reasons for implementation). Looking at the other ESM areas, the number of companies that have implemented measures is significantly lower. In the area of HVAC, only two fifth (13) of companies reported having implemented measures. In process improvement as well as power generation, a third (11 each) of companies have implemented measures. In the remaining ESM categories, less than a third (less than 10) of surveyed companies have implemented measures.

Comparing the numbers in Figure 1 and Figure 4, the areas in which the most ESM were recommended in audits are also the areas where the most measures were implemented. In the area of lighting, the number of companies that implemented measures (25) actually exceeds the number of companies that were recommended to implement in this area (21). In the HVAC sector, there are also more companies that have implemented measures than were actually recommended in audits. This may be due to the fact that companies had already implemented measures in these areas prior to their energy audits. Beside lighting and HVAC, the highest ESM implementation rates are in the areas of process improvements

and energy production. In all areas except lighting and HVAC, more measures in terms of numbers are recommended than actually implemented. The largest gap is in the area of process heat and cooling, where there are significantly more companies which were recommended to implement measures (13) than companies that actually implemented them (5). This may be due to high investment cost and longer payback-periods of process heat and cooling improvements. In all other areas, the number of companies that have implemented ESM is either the same as for drives/motors or pumps or a little lower.

3.2.2. Reasons for implementation

When asked about the reasons for implementing ESM in the companies, reducing energy costs and short payback periods were the most frequently selected answers. It indicates that the profitability of the investment is the priority of most companies. This was followed by of the measures and, at a slight distance, the reduction of CO₂ emissions on par with the improvement of economic efficiency. It is interesting to note that, although low investment costs were mentioned by some companies, they were selected rather less than the previously mentioned reasons. Reasons such as attractive subsidies, customer or employee requirements and legal requirements also played a rather minor role (see Figure 5).

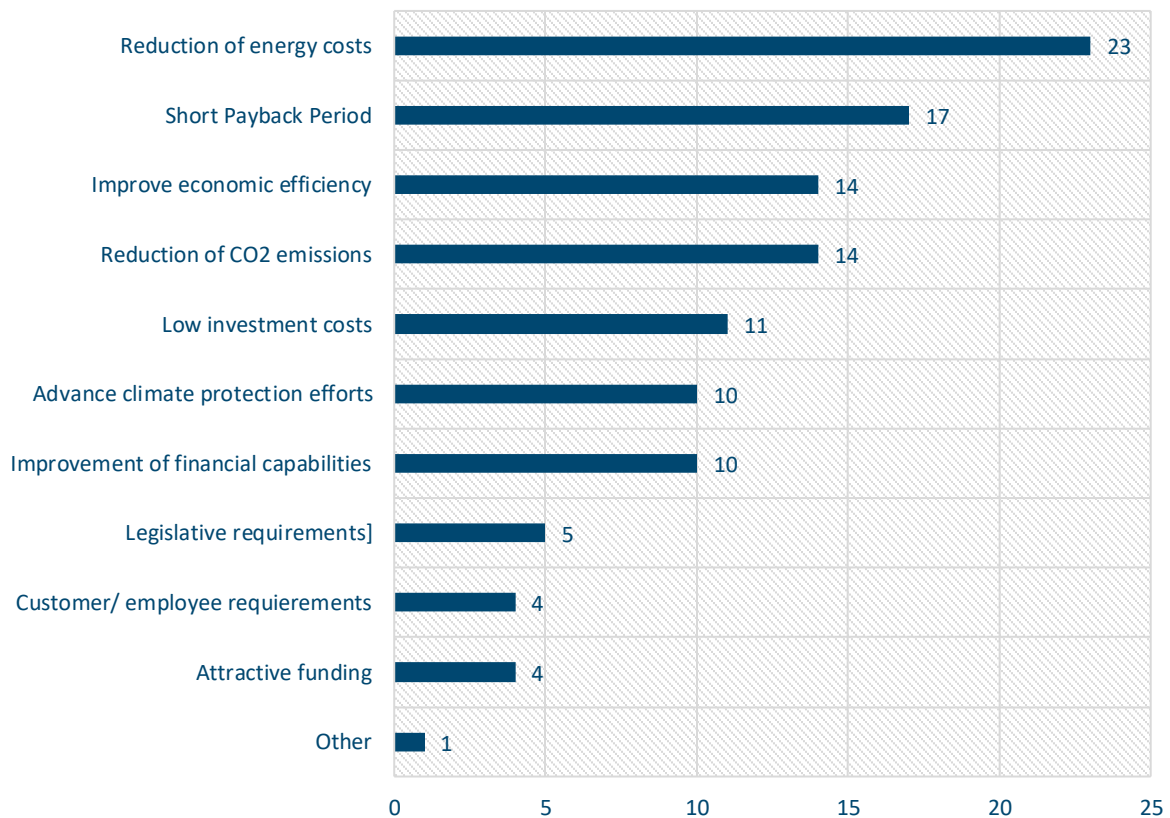


Figure 5: Reasons for the implementation of ESM according to 31 surveyed companies.

Companies were asked whether the decision to implement ESM was based on the audits and on what other indicators the decision was based. About half of the companies stated that investment decisions in ESM are partly based on the energy audits. Only a few said this was entirely true, while a third (11) of the surveyed companies said their investment decisions did not depend on the audits.

3.2.3. Reasons for non-implementation

In some ESM areas, measures were proposed during the audit but not implemented. This mainly concerns the ESM areas of process heat and cooling, processes and energy generation. In order to establish a link between certain measures and the reasons for their non-implementation, the corresponding data were compared. In process heat and cooling, the main reasons were high investment costs, long payback periods and prioritisation of other expenditures, lack of resources and lack of time. The situation for ESM in the process sector is similar. In power generation, long payback periods, high investment costs and lack of resources also played a role. Lack of funding was also mentioned several times, while lack of time played a lesser role.

In general, high investment costs, long payback periods, prioritisation of other expenditure and lack of funding were the most frequently cited reasons for not implementing measures.

The information provided by the companies is largely consistent with that of the auditors. The main reasons given by auditors for not implementing ESM were high investment costs, prioritisation of other expenditure, long payback periods, lack of subsidies and funds tied up for other investments, in that order. Also mentioned, but not as frequently, were lack of time, low potential for cost reduction and lack of knowledge among decision-makers.

3.2.4. Typical characteristics for implemented ESM

Companies were invited to name 3 exemplary ESM they effectively implemented and to describe their key characteristics. These questions led to a list of 37 exemplary ESM from companies. The most cited examples of implemented measures by interviewed companies were in the area of lighting, photovoltaic energy production, building and systems insulation as well as process heat, including heat recovery, representing about two thirds of mentioned measures. These proportions are very similar to the examples of suggested measures previously cited both by companies and by auditors.

The indicated investment costs of implemented ESM vary widely between 1,000 EUR and 10,000,000 EUR, similarly, to suggested measures. However, the mean investment cost lies around 620,000 EUR which is close to suggested measures mentioned by auditors and lower than the cost of suggested measures previously cited by companies. Generally, the indicated energy saving potential for the ESM lies between 5% and 60% of the energy consumption it applies to. The related CO₂ savings potential lies in the same range. This does not differ from the exemplary suggested measures.

The simple payback periods (SPP) of exemplary measures implemented by companies range from less than a year up to 18 years, with only very few measures exceeding 8 years. The median SPP of implemented and suggested measures is similar, at about 5 years.

4. COMPANY MINDSET ON ENERGY EFFICIENCY

Throughout the questionnaire, companies were asked to subjectively assess their own situation regarding energy efficiency by ranking a number of qualitative statements on a scale from 1 – “does not apply at all” to 6 – “does apply completely”. These results help to understand important factors underlying the decision-making process, such as the priorities of the companies and their perception of the need for action, the efforts already invested, and the impact of implementation.

4.1. Self-assessment of company commitments

The companies were first asked to give a self-assessment of their energy costs and their investments in energy efficiency and climate protection. When asked whether their energy costs are very high in relation to their turnover, two fifth (12) of the companies stated that this does apply and a third (11) said it rather applies. Only a seventh (4) of the companies indicated that the statement does not apply while another seventh (4) said it rather does not apply (see Figure 6). For the majority of companies surveyed, high energy costs are at least a serious factor that could potentially have a negative impact on their turnover.

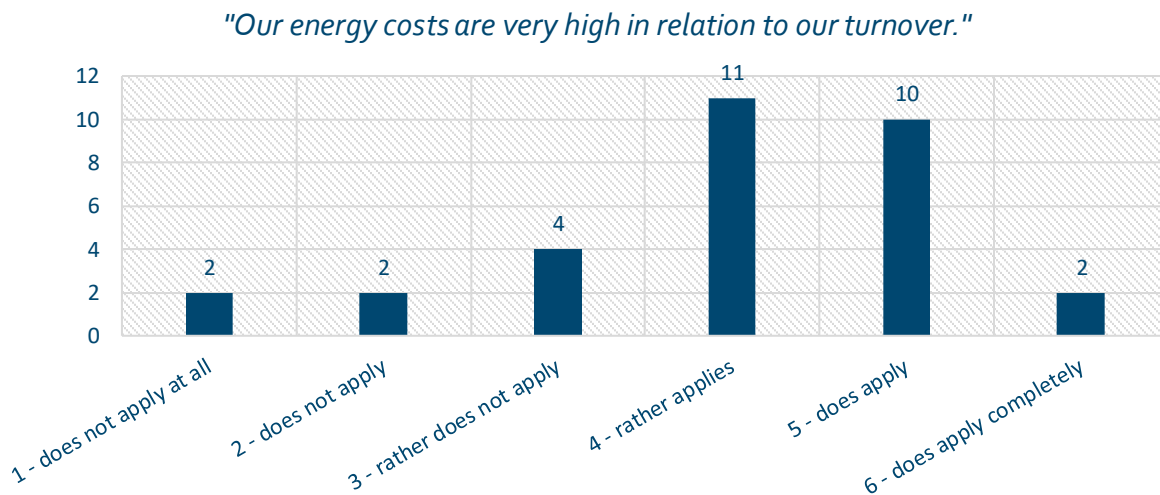


Figure 6: Survey responses to the statement “Our energy costs are very high in relation to our turnover” from 31 companies.

Almost two thirds (19) of the surveyed companies agreed that when they invest in energy-consuming equipment, they always make sure that the energy efficiency is improved at the same time. None of the respondents said this does not apply to them.

"We usually adjust to the requirements of environmental laws and regulations before they come into force."

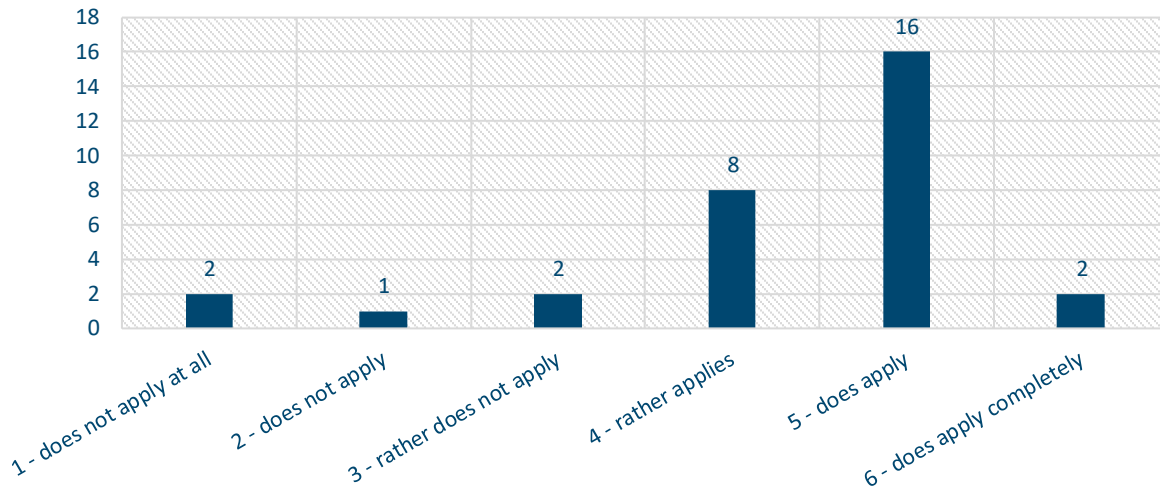


Figure 7: Survey responses to the statement "We usually adjust to the requirements of environmental laws and regulations before they come into force." from 31 companies.

Almost all companies stated that they usually adapt to environmental regulations before they came into force (see Figure 7). The majority also stated that they go beyond minimum environmental and climate protection standards. In addition, climate protection was considered important internally by most companies. It is worth noting that many of the companies see their commitment to energy efficiency and climate protection as mostly positive. However, more than half of the companies said that their costs for coping with the crisis and climate protection will be significantly higher than the cost savings they can achieve through further ESM (see Figure 8).

"Our expenditures to tackle the climate crisis will be significantly higher than the cost savings we can realize through further ESM."

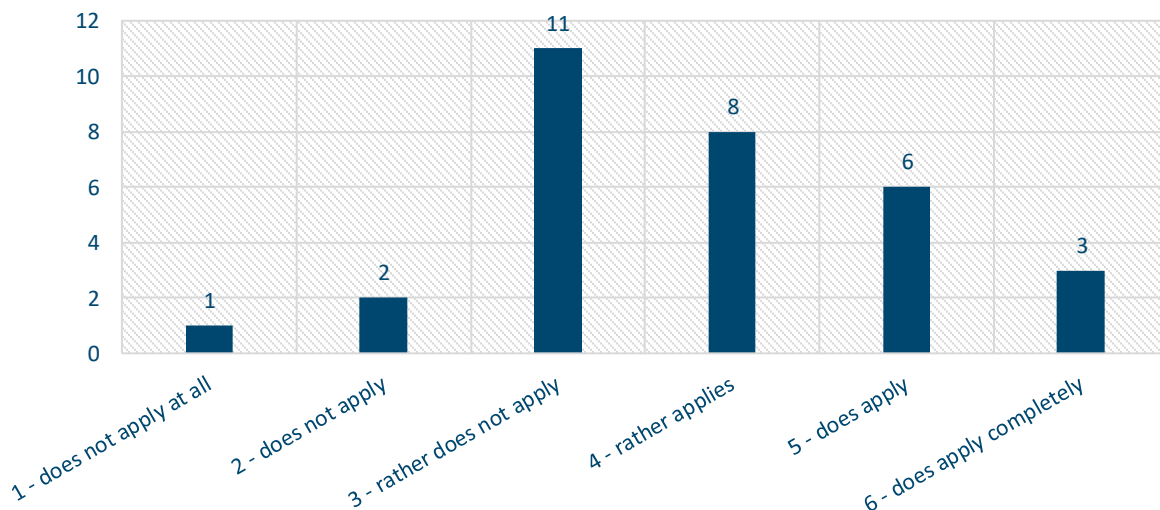


Figure 8: Survey responses to the statement "Our expenditures to tackle the climate crisis will be significantly higher than the cost savings we can realize through further ESM." from 31 companies.

4.2. Self-assessment of energy efficiency investments

Before being asked about the measures actually implemented following an energy audit, the companies were invited to another self-assessment. First, they were asked if there was a specific budget for energy saving measures. A large number of companies answered no. Of the 11 companies with a specific budget for energy efficiency, almost half (5) reported a budget of more than 100,000 euros per year. These companies are large in terms of turnover (above 50 million euros). Over a third (4) reported a budget of more than 10,000 euros and the majority of these companies are in the medium-sized turnover group. The small surveyed companies do not have any specific budget on energy efficiency investments.

Most of the companies with a specific budget for energy saving measures are also in the group with a budget for energy management, but not all. The budget for EMS and ESM is similar for many companies. Companies that invest heavily in management systems tend to invest heavily in measures and vice versa.

The self-assessment of investment in ESM was again based on a scale from 1 – “fully applicable” to 6 – “not applicable at all”. When asked whether they had already invested a lot in ESM, slightly less than half of the companies replied positively. A quarter (8) of the companies answered rather negatively. The remaining companies did not reply (see Figure 9). To the question whether they intend to invest a lot in ESM before the next audit, nearly half (14) of the companies answered positively while over a quarter (9) answered this question rather negatively (see Figure 10). When asked if there was still a lot of potential for energy efficiency in their company, a majority (19) of the companies answered positively. The answers to all three questions are mostly positive, which maybe be due to the aforementioned biases.

"We have invested a lot in improving energy efficiency since the last audit."

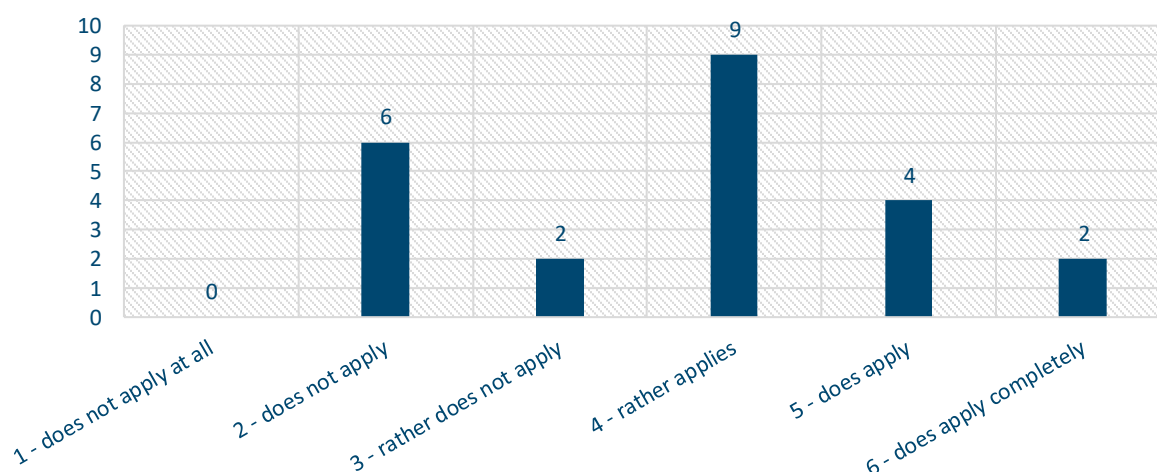


Figure 9: Survey responses to the statement "We have invested a lot in improving energy efficiency since the last audit." from 23 companies (8 companies did not respond).

"We will invest a great deal in improving energy efficiency between now and the next audit."

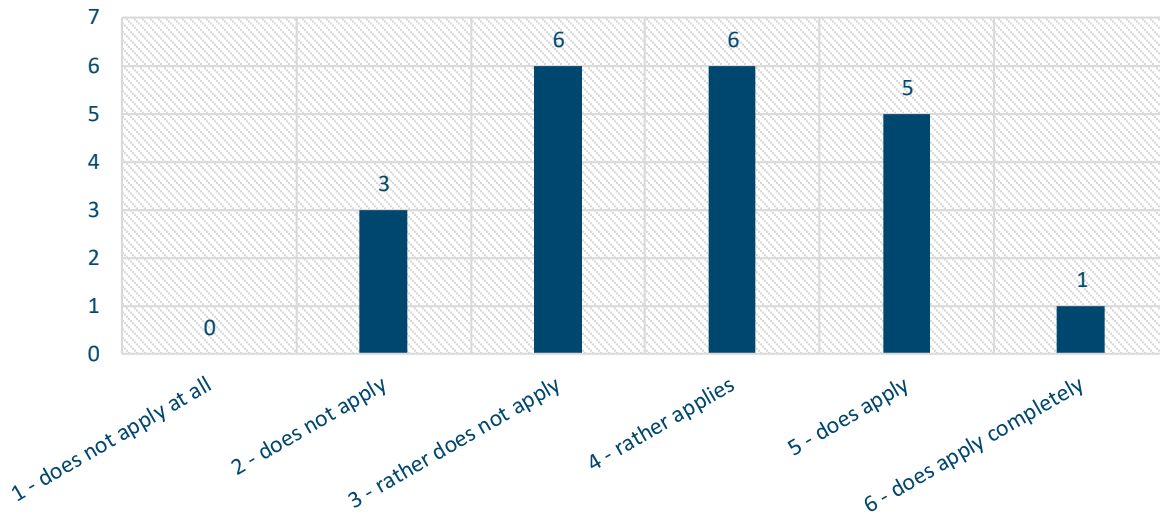


Figure 10: Survey responses to the statement "We will invest a great deal in improving energy efficiency between now and the next audit." from 23 companies (8 companies did not respond).

Finally, respondents were asked whether the energy-consuming equipment that companies need is now only available in energy-efficient versions. Half (15) of the companies answered in the affirmative, a quarter (8) in the negative (see Figure 11).

"Most of the energy-consuming equipment that we need is now only available on the market in EE variants."

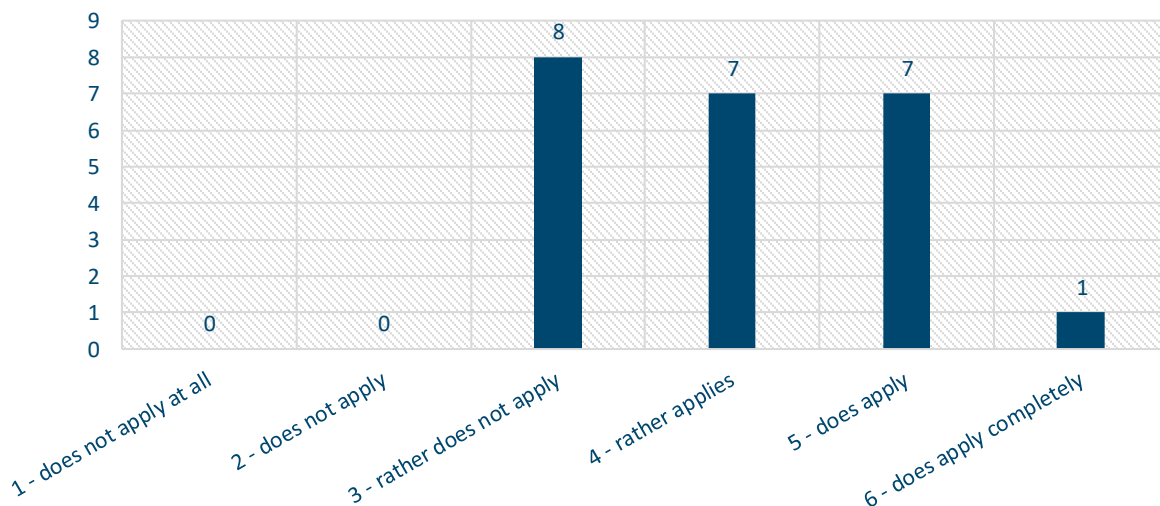


Figure 11: Survey responses to the statement "Most of the energy-consuming equipment that we need is now only available on the market in EE variants." from 23 companies (8 companies did not respond).

4.3. Self-assessment of the impact of ESM implementation

The companies were asked to assess whether and to what extent they were able to save energy costs by implementing measures. Two thirds (21) of the companies stated that they had been able to save the energy costs they had planned to save by implementing ESM, of which a third (11) were even able to save a little more than they had planned. A little less than

third (10) reported that this was not the case (see Figure 12). In response to the statement that the companies were not able to save as much energy as they could have despite the ESM, two fifth (12) of companies answered this was true. The majority of companies stated that there was still a high potential for savings through ESM in their companies, which had not yet been exploited (see Figure 13).

"As a result of the ESM(s), we have been able to save approximately as much energy as we had predicted."

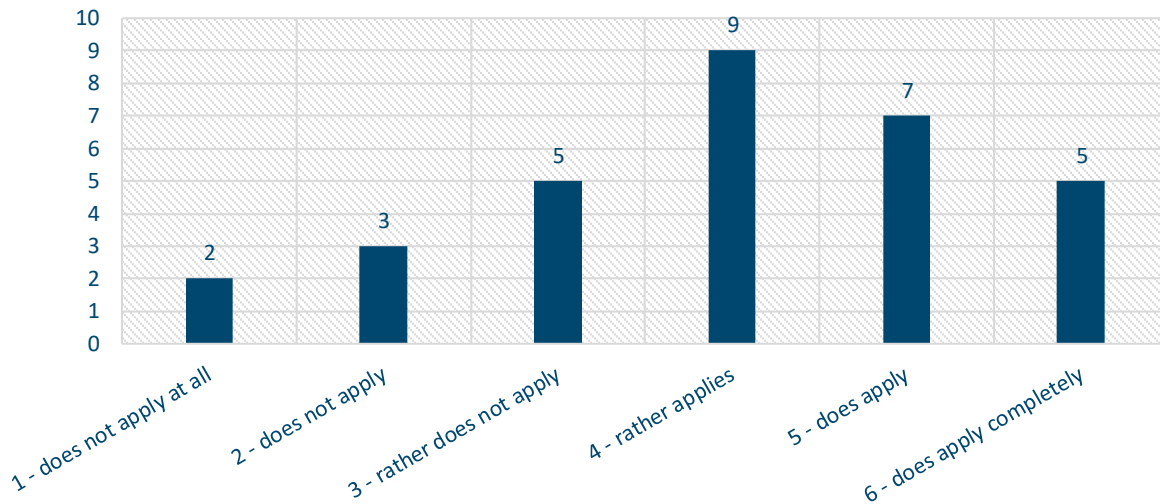


Figure 12: Survey responses to the statement "As a result of the ESM(s), we have been able to save approximately as much energy as we had predicted." from 31 companies.

"We have a lot of potential to save even more energy through further energy efficiency measures."

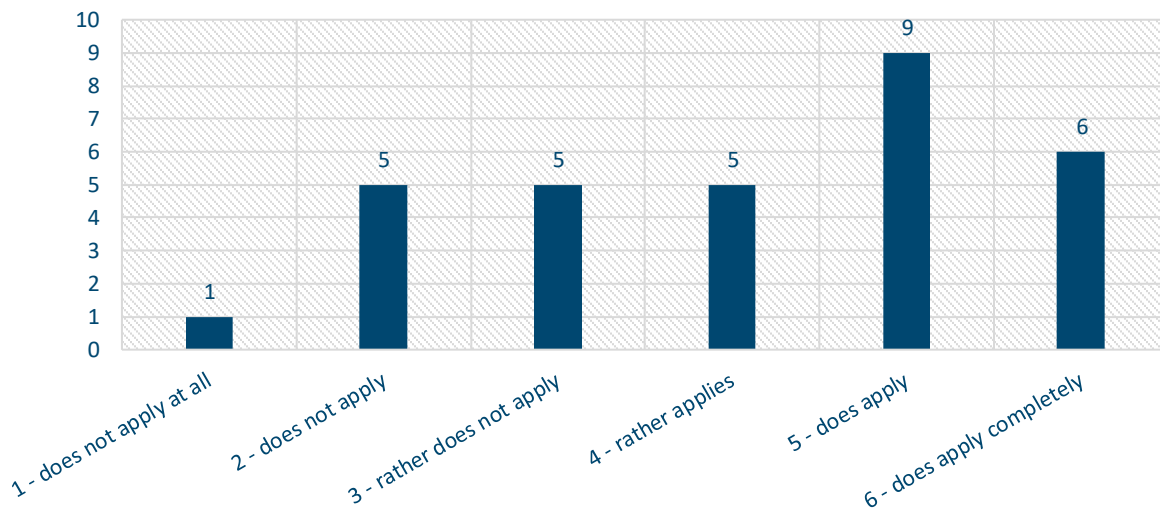


Figure 13: Survey responses to the statement "As a result of the ESM(s), we have been able to save approximately as much energy as we had predicted." from 31 companies.

When asked where they would reinvest the cost savings from ESM, companies were able to choose and rank the options: further energy efficiency measure, production increase, innovation, staff and other types of investments in the company that are not energy efficiency-related from 1 – "hardly ever" to 6 – "constantly". A large proportion of

respondents indicated that they would mainly invest the costs saved in other types of investments not related to energy efficiency. In fact, only just over half said they would reinvest in new ESM. Yet increasing production, investing in innovation and investing in staff are also not likely to be refinanced by energy cost savings (see Figure 14).

How often are cost savings as a result of ESM reinvested in:

- 6 - constantly ■ 5 - very frequently ■ 4 - frequently
- 3 - rarely ■ 2 - very rarely ■ 1 - hardly ever

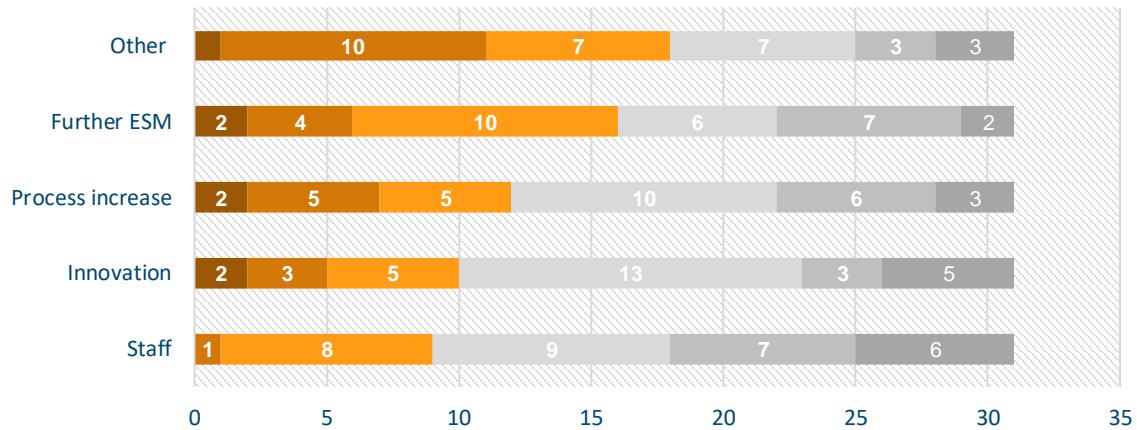


Figure 14: Survey responses to the question "How often are cost savings as a result of ESM reinvested in further ESM, process increase, innovation, staff or others?" from 31 companies.

5. DECISION MAKING

This chapter looks at the internal decision-making process of industrial companies on energy efficiency investments, including the actors involved and the reasons for deciding for or against specific ESM. Ultimately, this chapter analyses how different factors and characteristics of companies interact with each other and influence ESM implementation.

5.1. Actors and processes

Staff in charge

When asked which person or department in the company is responsible for decisions regarding the implementation of measures, almost all (12) of the large companies in terms of number of employees stated it is their management board. Almost half (5) of them additionally stated that middle and lower management also made implementation decisions and almost half (5) also indicated that specific energy management personnel are involved in the decisions as well. A few others among large companies also indicated technical staff. Despite the comparatively large number of employees and additional staff involved, the management board is still responsible for the decision-making process in almost all of the large companies.

The situation is similar for the (15) medium-sized companies. Here, over two thirds (11) companies reported that decisions on the ESM were taken by the board of directors. Very few of the companies reported that other levels of management were responsible or jointly responsible for decisions on the implementation of the ESM. From the 4 small companies surveyed (less than 50 employees), 2 companies take their decisions based on the board of directors and 2 companies take decisions based on lower management levels.

Auditors were asked who, in their experience, has the authority to decide on the implementation of ESM by means of an open question. According to the auditors, the investment decision is often made by senior management or the management board. This is often supported by the technical or energy management department, which is also responsible for implementation.

Decision-making process

This was similarly described by most of the companies in response to an open question about their decision-making process. In some of the companies, management board sets savings or climate targets to be achieved. In almost all of the companies surveyed, management board makes the final decision to invest in energy efficiency and also decide on which specific ESM to implement. They give a mandate or consult with the company's technical or energy management department before deciding. The decision-making processes described by surveyed companies mostly follow a top-down approach.

Decisions are based, for example, on a cost-benefit analysis of the different measures and an estimate of the complexity of the effort. Another indicator for a decision is the availability of funding. Furthermore, measures are only implemented if there is a need to improve certain processes. Several companies mention the individual steps of the decision-making process. In general, it can be said, that they are often quite similar. It starts with monitoring the existing processes, which leads to an idea of how to improve these processes. Then an analysis of the process is made and different possibilities are looked for. Next, initial

calculations for ESM are made. These are presented to management together with a proposal for the implementation of an ESM. The proposal shows the expected impact of the measure in terms of energy cost savings. Management gives its approval and the measure is implemented. Finally, the energy cost savings are monitored to validate the impact of the ESM.

The role of energy auditors

This part of the report examines the role of auditors in, and their influence on, the ESM's investment decision-making process. In particular, auditors were interviewed. They were asked, among other things, who their main contact in the companies was. The majority of auditors reported either energy management or technical staff as their main contact. This is coherent since, as described above, they are often internally responsible for analysing processes and potential for ESM. In most cases, however, the decision to carry out an energy audit is taken by higher levels of management or the board of directors. In a few cases it is also made by the energy manager or by middle or lower management. Typically, the auditors will involve the company's internal energy managers, technical department or production managers in the audit process.

The main reason for carrying out audits in companies, according to the auditors, is the legal obligation. Other relevant reasons include the opportunity to reduce energy costs, the implementation of a management system and, in some cases, the use of funding programmes.

At the end of the audit process, the auditors present an audit report to the companies. They also reported that they often prepare additional presentations for energy management or for senior management or the board. For all but one of the auditors interviewed here, the report includes a list of ESMs, including a financial assessment of them. For four fifths (28) of the auditors, the report also includes a breakdown of the company's energy demand and consumption. Less than a third (13) of the auditors prepare an action plan for implementing the measures, including time, resources and risk assessment. While a little over a quarter (10) also prepare a monitoring plan to verify energy savings.

Auditors were asked about strategies to help companies implement ESM. A common strategy is to put companies in direct contact with service providers who can implement the measures immediately. Some of the auditors also identify funding opportunities, such as subsidies and grant schemes, put companies in touch with contractors or, in the case of ESCOs, offer to fund or implement the measures themselves. In addition, some of the auditors offer structured follow-up processes and training for company staff.

Comparing the auditors' statements with those of the companies, it is clear that management, despite having the final decision-making power, is still not sufficiently informed or aware of the relevance of the EMS to their operations. Management, therefore, needs further training on energy efficiency.

5.2. Factors influencing the decision-making process

ESM performance indicators

The companies surveyed were asked to indicate on a scale of 1 – “not at all relevant” to 6 – “very relevant”, which indicators were most relevant to the implementation decision. They

should assess the following indicators: payback period, impact/reduction potential in CO₂ and energy, potential cost savings, investment costs, availability of funding and climate protection. All of the indicators surveyed were rated as rather relevant to very relevant by well over half of the companies.

Potential energy cost savings were cited as the most relevant, with all companies responding positively. This was followed by investment costs, payback period and the potential for energy and CO₂ reductions. This confirms that companies prioritise profitability in their ESM investments, especially in regard to rather high energy costs compared to turnover.

The availability of subsidies and interest in climate protection were also rated as relevant with a minimal gap (see Figure 15). Interestingly (as mentioned in 3.2.2), companies do not consider subsidies as an important factor for implementing ESMs; however, available subsidies do appear to play a role in choosing which ESM to implement once the decision to invest in energy efficiency was taken.

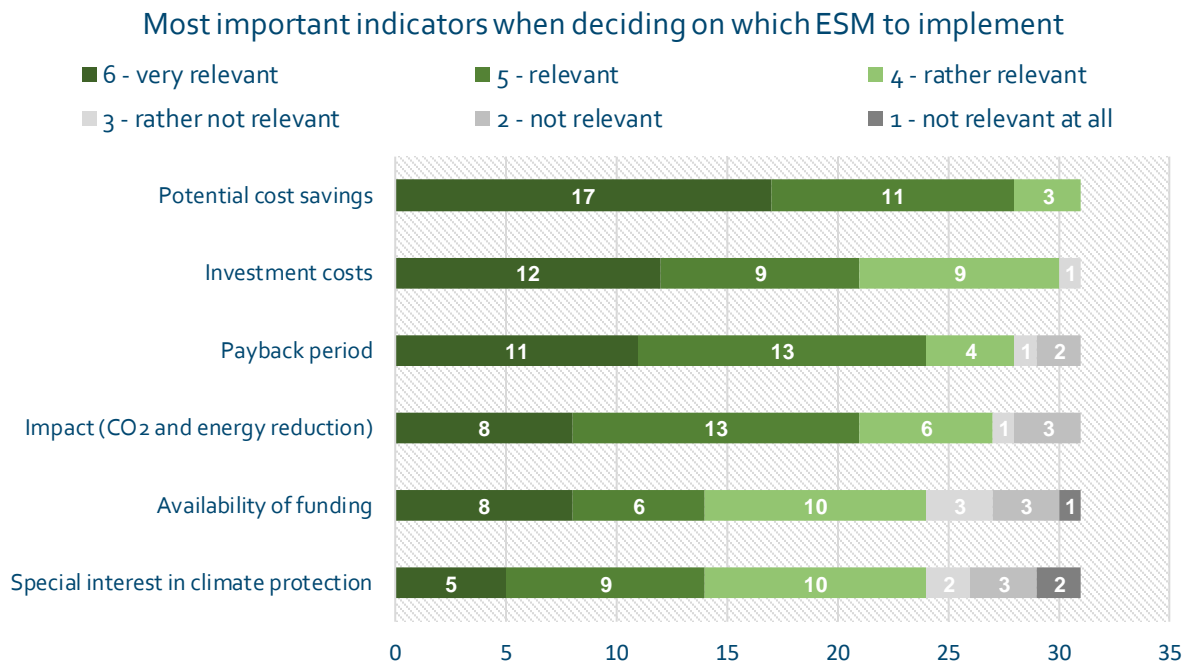


Figure 15: Survey responses to the question "What are the most important indicators when deciding on which ESM to implement?" from 31 companies.

One question concerned the timing of investment in energy saving measures. Companies were asked when exactly they invest in ESM. The question aimed to find out whether they only invest when there is a concrete need or whether they would also invest outside of an acute need. A little under a half (14) of the companies invest in ESM when there is defective equipment to be replaced. Two fifths (12) of the companies stated that they would also invest if the opportunity arose to replace old, functioning equipment with new, energy-saving equipment. Reorganisation of operational processes, optimisation of stock and new projects such as new production facilities were also mentioned by some companies, but not as frequently as the first two reasons.

Energy efficiency targets

Of all surveyed companies, less than a third (10) said they had internal energy saving targets, while another third (10) said they had none. Less than a quarter (7) said they had set a target

to reduce CO₂ emissions. A sixth (5) of the companies stated that they checked the targets after implementation and achieved them. Almost none of the companies published their energy saving targets. It is unclear what exactly the internal targets refer to, as companies often did not provide more specific information.

Grants and subsidies

Two fifth (12) of surveyed companies used grants or loans to finance the ESM. These covered varying percentages of the total cost. Regarding the percentage of grant coverage of ESM measures, responses ranged from 5 to 60 per cent.

5.3. Impact on ESM implementation

This final section is a rudimentary assessment of the impact of certain key characteristics of interviewed companies on their readiness to improve energy efficiency. However, due to the small and relatively heterogeneous sample, the results of this cross-analysis are generally insufficient to establish clear causal links between factors and impact. Weaker trends among sub-categories of companies were discarded.

Does ESM implementation reflect climate claims?

Most (26) of the surveyed companies stated that they adapt to the requirements of environmental laws and regulations before they came into force. Very few (5) companies said they did not. About half (13) of these companies reported that they had invested a lot in improving the energy efficiency of their operations. Among those, a majority also reported that they were carrying on energy efficiency investments presently and in the future, and almost all also indicated they still have a large potential for savings.

Half (13) of the 26 early adopters confirmed that most of the energy consuming equipment they need is now available in energy efficient versions. A similar number (12) of said that they always invest in ESM when defective equipment needs to be replaced. Slightly fewer (11) of them reported that they replace working equipment with more energy-efficient equipment. Beside these indications, the interviews did not provide further information on how preventive adaptation to energy efficiency requirements is approached in companies. In the group of 26 early adopters, a large proportion reported that their ESM implementations had delivered the expected energy savings, and often more than planned. Only a few of the companies said that some of the measures did not deliver the expected savings.

On all these assessments, a very similar picture emerges for the 25 companies which said they would go beyond the standards. In the group of companies which said they do not adapt to new requirements in advance, the responses are more varied. As their number is very small, it is not possible to identify clear patterns within this group.

Do internal energy and climate targets influence implementation?

The 10 companies that reported having internal energy saving targets also reported that the majority had already invested heavily in energy efficiency. Two thirds (7) of them also reported that they still have a lot of savings potential in their companies. The majority of companies with internal savings targets stated that they invest in energy efficiency both when equipment is defective and when it is still working. The majority of companies with internal savings targets also reports that they adapt to national or international standards at

an early stage and usually go beyond them. However, these answers do not differ significantly from those of companies that have not set internal targets.

Generally, it appears that internal CO₂ emissions or energy saving targets do not have a significant impact on the readiness to implement ESM among interviewed companies. Only 2 companies publicly announced their targets. Although their answers tended to be generally more positive, their number is too small to draw any meaningful conclusions.

Does having internal energy management staff influence implementation?

The share of companies indicating they usually adjust to the requirements of environmental laws and regulations before they come into force appears to be higher among companies with internal energy management staff (20 out of 22) than companies without internal energy management staff (6 out of 9). However, the absolute difference is too small to draw conclusions.

Almost all companies which do not have internal energy management staff also indicated not having a dedicated annual budget for energy saving measures (8 out of 9), while half of the companies with internal energy management staff indicated having a dedicated budget (11 out of 22). In addition, a larger share of companies with internal energy management staff confirmed they still have a lot of potential to improve energy efficiency (12 out of 22) than companies without internal energy management staff (2 out of 9). This may indicate a better awareness of energy saving potentials among companies with energy management staff. In general, the completion rate of the interviews was higher among companies with energy management staff.

Regarding the people involved in decision-making on ESM implementation, there is no significant difference found between the interviewed companies with and without energy management staff. Even among companies with dedicated staff, the decision making appears to take place predominantly on management board level.

Does having an energy management system impact implementation?

Companies with an energy management system (whether ISO5001 certified, EMAS certified or other) predominantly had internal energy management staff (7 out of 8). Most of them also indicated having an annual budget for energy saving measures (6 out of 8), this appears to be significantly more than companies without and EMS (only 6 out of 23). All of the companies with an EMS said they adjust to the requirements of environmental laws and regulations before they come into force. All of them also indicated they have a lot of potential left to improve energy efficiency (8 out of 8), while only less than half of companies without EMS said so as well (11 out of 23). All surveyed companies with an EMS consider climate protection and their CO₂-impact as decisive factors in their decision-making process, while these topics play less of a role among other companies. All of them did implement at least one energy saving measure (beside lighting). This implementation rate is slightly lower among companies without EMS.

CONCLUSION AND KEY FINDINGS

Based on in-depth questionnaires addressing both industrial companies and energy auditors, this report provides qualitative insights on the perception of energy efficiency in companies, on the stakeholders and on the factors underlying the decision to implement or not implement ESM. Main findings from this survey are summarised below:

- **Company mindset:** High energy expenses are a serious concern for all surveyed companies, affecting their profit. The majority see their commitment to energy efficiency and climate protection in a positive light. In fact, most companies said they anticipate new energy efficiency regulations and try to go beyond current environmental standards. Although many indicated already heavily investing in energy efficiency, the majority of companies are aware that there is still a lot of potential for energy savings left to exploit. Yet, very few of the surveyed companies have an energy management system or a dedicated annual energy efficiency budget in place. Cost savings from successfully implemented ESM are not clearly redirected to further ESM, but process increase and innovation also don't appear to benefit significantly from energy savings reinvestments. According to surveyed auditors, many company managers need further training to gain awareness on climate issues and familiarise with energy efficiency and its benefits. In general, companies with in-house energy staff seem to have a greater awareness of these issues.
- **Decision making process:** Most surveyed companies do have internal energy management staff (either as a team or part-time). In almost all cases however, the decision to invest in ESM is made primarily by the top management level. Internal energy management staff, if existing, or technical staff may also be involved. Typically, the management board will set efficiency targets and the energy manager or auditor will make an ESM implementing plan based on the audit, which then management approves or rejects. Decisions on which ESM to implement are mostly based on needs, cost-benefit analyses, the complexity of the effort and the availability of funding. Many of the surveyed companies still do not have clear targets for energy or CO₂ savings.
- **Recommendations in energy audits:** For the economic assessment of suggested ESM in audit reports, the internal rate of return (IRR) and the net present value (NPV) were the most cited metrics by auditors, outranking the simple payback period (SPP) calculation. Across all countries, auditors appear to comply but rarely exceed national requirements and guidelines for the economic assessment of ESM in their audit reports to companies. Over a third of auditors do not refer to NEBs what suggesting ESM. What is more, less than two thirds of auditors provide implementation guidance in the form of investment and monitoring plans in their reports.
- **ESM implementation gap:** According to companies and auditors, the most recommended ESMs are in the areas of lighting, process improvement, process heat and cooling, HVAC, power generation, compressed air and drives/motors and pumps. The survey showed that companies are primarily implementing measures in the ESM areas where the audit recommended action. The area of lighting stands out, as it is often associated with lower levels of investment. The largest gap between recommended and

implemented ESM is in the area of process heat and cooling, which might be due to higher investment cost and longer payback periods.

- **Reasons for implementation:** The decisive reasons for the implementation of ESM are energy cost savings, short payback period, the carbon footprint reduction of CO₂ emissions and the improvement on economic efficiency. Companies appear to prioritise profitability in their ESM investments, though savings are not primarily reinvested in process increase and innovation. This is coherent with the reasons behind non-implementation. Subsidies for energy efficiency do not appear to play a significant role in the decision to invest in ESM, however they do influence the kind of ESM companies choose to implement. The most frequently mentioned NEBs were the same for auditors and companies, indicating a good knowledge of most common NEBs: climate change mitigation, improved health and safety conditions, improved working environment, improvement of ESG indicators as well as environment and resources protection, such as reduced waste and water consumption, security of supply and self-sufficiency.

Overall, surveyed companies appear to be aware of the importance of energy efficiency, while economic considerations are the main reason limiting implementation at scale. No matter the size of the company, top management remains in charge of deciding on energy efficiency investments and the choice of ESM. Further awareness raising and training for management staff would therefore benefit the uptake of ESM. Generally, surveyed companies trust the results of their energy audits, as no major discrepancies were found between the ESM assessments from companies and auditors. The auditor thus plays a significant role in the decision-making process and the level of detail and quality of the guidance provided in audit reports should be further analysed in the context of the AUDIT2MEASURE project. In particular, the Audit2Action strategy will ensure that the point of view of auditors is adequately considered in order to increase the uptake of ESM in manufacturing industries.

ANNEXES

ANNEX 1: AUDIT₂MEASURE SURVEY QUESTIONNAIRE FOR COMPANIES

ANNEX 2: AUDIT₂MEASURE SURVEY QUESTIONNAIRE FOR AUDITORS

ANNEX 3: AUDIT₂MEASURE COMPLETE SURVEY RESPONSES