EU-MERCI

EU coordinated **ME**thods and procedures based on **R**eal **C**ases for the effective implementation of policies and measures supporting energy efficiency in the **I**ndustry

HORIZON 2020 Project Nr. 693845

Barriers and costs from EEOSs and alternative measures from a market perspective

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For more information on the project EU-MERCI, link to http://www.eumerci.eu

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Abstract

This report highlights the barriers and costs that industrial European companies face while implementing energy efficiency measures to achieve the targets of the European Directive on Energy Efficiency (EED), especially with respect to the targets and policies of Article 7. The report is based on a bottom up study, which takes a market perspective to identify both barriers and good practices in energy efficiency adopted by industry.

The results of the survey, along with other actions of the EU-MERCI project, will support the elaboration of recommendations for both policy makers and authorities and guide them in the process of making future policies targeting the implementation of energy efficiency measures in industry.

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List of Abbreviations and Acronyms

Abbreviation/Acronym	Meaning
EU	European Union
EE	Energy Efficiency
MS	Member State
EEO scheme	Energy Efficiency Obligation Scheme
EU-MERCI	EU coordinated MEthods and procedures based on Real Cases for the effective implementation of policies and measures supporting energy efficiency in the Industry
ESCO	Energy Service Company
National Databases	The databases that each ENABLER owns and consists of audits of energy efficiency measures in industry in the specific country

Information about the EU-MERCI project

EU-MERCI is a coordination and support action project funded by the European Commission under Horizon 2020 (nr. 693845), aimed at fostering and facilitating the implementation of energy efficiency projects in the manufacturing industry sectors by selecting and disseminating technological and policy good practices.

The project

EU-MERCI seeks to identify good practices for the implementation of energy efficiency projects, drawing from the experience of thousands of real cases from the delivery of energy efficiency support schemes in Europe (supporting the effective implementation of the EU Energy Efficiency Directive).

The collected case studies, disseminated through an extensive capacity building action, will allow industrial enterprises to identify and implement the opportunities related to energy efficiency actions. Further, the analysis of the existing energy efficiency support schemes will support policy makers in designing new support schemes or improving existing ones. The lessons learnt from countries with consolidated energy efficiency schemes in place will be transferred to countries less advanced in this area.

A stakeholder community dealing with industrial energy efficiency policies and actions will be created, to accelerate and facilitate the path towards the 2030 energy efficiency targets.

A repository of industrial good practices

A database of industrial good practices will be created through the analysis of the EE projects implemented within the existing support schemes at EU level and the information collected via an extensive survey involving both industries, their associations, and policy makers. This repository will be available to all the interested stakeholders through a dedicated web platform. Despite the rising of awareness over the last few years, many energy efficiency actions are still not implemented. This is due to a lack of knowledge of good practice examples and other information barriers. The collected good practices will help industrial enterprises to identify the best available solutions to improve their use of energy and their competitiveness and will stimulate them by showing case studies and real achievements.

Support actions for industries

Besides the good practices repository available at www.eumerci.eu, EU-MERCI will support the implementation of energy efficiency projects in the industrial sector through dedicated conferences and workshops, organized both in the EU-MERCI partners' countries (Austria, Bulgaria, Greece, Italy, Romania, Slovenia, The Netherlands, UK) and in the other countries covered by SPES GEIE consortium for the agri-food industry (Belgium, Czech Republic, France, Hungary, Portugal, Spain, Turkey). Dedicated webinars will also allow for a wider attendance from all the EU countries.

Support actions for policy makers

EU-MERCI will support policy makers to design new schemes and improve the existing ones. The analysis of the existing support policies for energy efficiency, together with the detailed investigation of the technological case studies, will offer a comprehensive view on the different issues of energy efficiency support schemes (energy savings measurement and verification, reference baseline,

additionally features of the implementation, materiality, etc.).

Community of stakeholders

EU-MERCI will involve an important number of national and European stakeholders, tracking the project from the analysis of measures up to the dissemination of the energy efficiency good practices. This community will act both as a supplier of relevant information and case studies, as well as the beneficiary of the analysis findings and project outcomes. Social networks will support communication channels allowing for the exchange of information and experiences.

Partners

The project partners, working to seek, develop and disseminate good practices are:

Ricercasul Sistema Energetico, Italy (RSE); JIN Climate and Sustainability, The Netherlands (JIN); Center for Renewable Energy Sources and Saving, Greece (CRES); Polish National Energy Conservation Agency, Poland (KAPE); Austrian Energy Agency, Austria (AEA); Italian Federation for Rational Use of Energy, Italy (FIRE); Carbon Trust, United Kingdom (Carbon Trust); Black Sea Energy Research Centre, Bulgaria (BSERC); Energy Restructuring Agency, Slovenia (ApE); Spread European Safety SPES GEIE (SPES); Centre for the Promotion of Clean and Efficient Energy in Romania, Romania (ENERO).

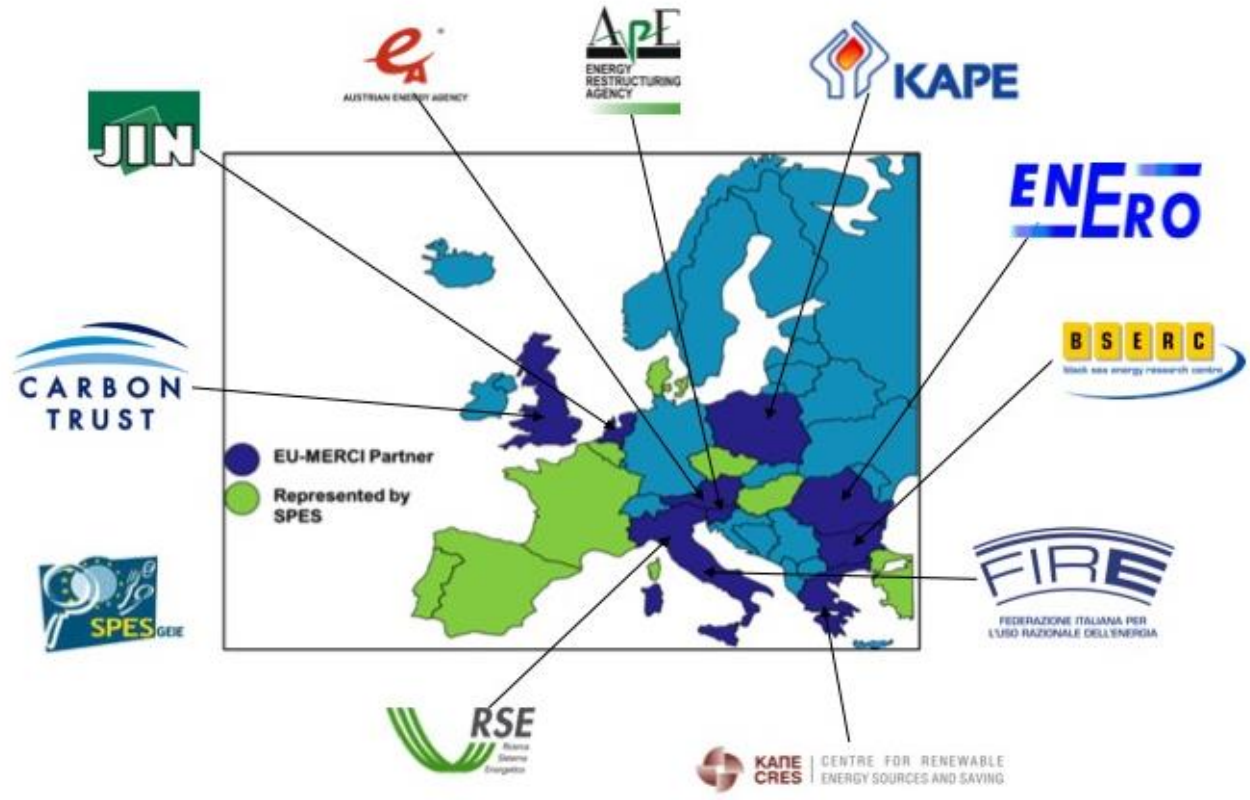


Figure 1: EU-MERCI partners

Executive Summary

EU MERCI aims to increase the energy efficiency in the European industry by identifying good practices of implementing energy efficiency projects and recommending common procedures, shared methods and supporting tools to assist industries in improving the energy efficiency of a process. Major pillars of the EU-MERCI action are the collection of in-field data on really implemented efficiency measures and the direct capture of the experience and point of view of stakeholders about approach, benefits and barriers of efficiency measures and policies.

With these objectives, a survey was designed aiming: to register the awareness of EU industry of the efficiency problem in the industry processes and the potential multi benefits related to efficiency interventions; to understand the trends in the implementation of energy efficiency solutions in the manufacturing processes; to get the perception of stakeholders about barriers and weaknesses (of technical and non-technical nature) in the implementation of existing energy efficiency policies, measures and mechanisms as well as about the necessary investments associated with the energy efficiency improvements and the way to get them.

Questionnaires were chosen as the tools of the survey, respectively tailored to address different targets: companies, sector associations and ESCOs. The Questionnaires (on Google or word format) have been made available online, for compilation, from June to October 2016.

The questionnaires were composed by 36 single and multi-option questions, grouped in three different sections: identity and energy profile of the participants; approach to efficiency and technical solutions and trends; perception of benefits and barriers about policies and investments. .

Feedbacks from about 150 questionnaires were processed, the most of them from the industrial companies of 9 different countries (Italy, Bulgaria, Romania, Slovenia, Netherlands, Poland, Greece, Czech Republic and the UK). Also, 15 ESCOs and 13 Associations responded to the survey.

The majority of the respondents were medium and very large size companies with good level of awareness of the efficiency issues. Their average energy costs range from 2 to 10% in relation of their turnover. The majority of companies have participated in a support scheme, appointed an energy managers and have conducted energy audits. Companies which are not aware of energy efficiency opportunities turn to ESCOs or Associations for support.

The majority of companies have carried out energy efficiency measures in recent years, mostly aiming to reduce energy costs. Manufacturing industries are the most involved in the efficiency process. After the implementation of the measures, there had been a reduction of energy costs up to 5% or up to 10%, which is deemed as a satisfactory result for the companies.

The main reason for not having implemented energy efficiency measures so far was the economic inconvenience tied to the high investments and the difficulties to get the funds. Generally, where measures had been implemented, a reduction of up to 5% or 10% was observed, which was perceived as a satisfactory result for the companies. The majority of the companies used their own capitals to cover the initial costs of the investments, while those that had made use of financial instruments mainly chose subsides to support them. By general agreement, the most important barrier for the implementation of energy efficiency measures was the too long payback period, followed by the high level of bureaucracy. The knowledge of the available technical and technological

solutions is considered the most important factor for the positive development of energy efficiency measures.

Both similarities and differences can be observed from the answers provided by the three target groups (individual companies, ESCOs and industry associations). In general, although initial investment costs and too long payback periods are considered to be important barriers for the implementation of energy efficiency measures, most companies chose to invest in energy efficiency measures using their own capitals, leading to the conclusion that a high level of bureaucracy required to receive the grants seems to be an even more significant barrier. However, it should also be noted that subsidies are still perceived to be also a recurrent measure to finance energy efficiency.

Interventions applied to the manufacturing processes, aiming at reducing the energy cost were generally considered to be effective interventions. The majority of interventions resulted in a reduction between 5% and 10%, which is more or less what had been expected, and is considered a satisfactory result.

The current level energy awareness and the energy management approach of the industries is considered to be satisfactory, as the analysis shows that most of the companies have either energy managers, use energy performance indicators, are certified by ISO 50001, or are turning to ESCOs and/or associations for assistance. Information on current trends in energy efficiency as well as knowledge on their energy profile, existing energy regulations and the stability of the frame conditions, seem to be crucial for companies to invest and implement energy efficiency measures in the future.

1 The survey campaign

1.1 Aim of the survey

The aim of the survey was to identify the extent energy efficiency measures have been implemented across industries in various Member States (MSs), according to the Energy Efficiency Obligation Schemes (EEOS) and alternative measures to achieve the targets of the European Directive on Energy Efficiency (EED). The main source of information were questionnaires and interviews to key industrial and service players across the EU, to provide a market perspective on both the barriers and good practices used to implement energy efficiency measures. Market perspective entails here aspects like costs, investments, technology solutions, organization adaptations, bureaucracy issues, etc., all factors affecting, in the end, the competitiveness of the European manufacturing industry. The final goal is to understand the specific market barriers that industries face when implementing efficiency measures, as well as to identify the bottlenecks impacting the costs of efficiency.

Furthermore, a research gathering the current EU policies concerning the implementation of the Article 7 has been conducting, focusing in the parameters related to the transaction cost and how each country has decided to overcome this barrier. Data has been gathered from existing databases, which had been created under the implementation of other EU projects (ENSPOL, ODYSSEY-MURE) and other official databases. In order to execute a more detailed analysis linked to the EU-MERCI targets and to exploit the current participant industries, a cross-reference analysis has been made with the respective questions from the survey for each country and their energy efficiency policy.

This survey is one of a number of actions put in place by EU-MERCI to directly involve industrial stakeholders in the evaluation process.

1.2 Objectives of the survey

The survey had the following objectives:

- To assess the level of awareness among EU industries of the importance of energy efficiency and the potential benefits related to the interventions
- To examine the general perception and state of energy efficiency implementation across industries
- To understand the barriers and weaknesses (both technical and non-technical) of existing energy efficiency policies, measures and mechanisms at a national level from the perspective of industry stakeholders
- To appreciate the costs and related issues associated with the implementation of energy efficiency improvements (including “bureaucratic”/transactional costs) compared to the benefits

The survey included interviews with individual stakeholders to discuss in more detail the issues touched upon in the survey.

This survey was targeted to industrial companies and industry representatives (such as sector associations) as well as to energy efficiency service providers.

1.3 The campaign

The survey campaign was mainly conducted through questionnaires. The questionnaires were tailored to enable responses from companies, industrial sector associations, and ESCOs. The campaign was open from July 2016 to October 2016 and the questionnaires were accessible through the EU-MERCI website. This report deals with the feedbacks gathered in that period. However, the questionnaires will continue to be accessible online until the end of the project.

The questionnaires have been prepared by the EU-MERCI consortium and developed in Google forms to allow online submission. They are also available in Word files, when required. A guide was produced to assist in responding to the questionnaire. The set of questionnaires was circulated by the EU-MERCI partners to all three stakeholder groups. Questionnaires were also translated by the members of the EU-MERCI consortium to their national language, to facilitate the stakeholders in the compilation. Interviews were also conducted, in order to reinforce the procedure. Further, more complicated and case- specific analysis of the answers was made, in order to be able to provide a more detailed, deep and case or country- oriented perspective for the conduction of the conclusions. Hence, some of the Figures of this document have different format than the one provided by Google forms.

The questionnaires were first tested by members of SPES (EU-MERCI partner) for the agri-food industry.

The results of the survey have been analysed with absolute confidentiality, protecting the identity of the respondents. To further ensure confidentiality, the results have been presented in an anonymous and aggregated way.

1.4 Description of the Questionnaires

The aim of the questionnaires was to gather information on the current status and trends on the implementation of energy efficiency measures in the European industries. Three different formats were tailored, respectively addressed to industrial companies, industrial associations and ESCOs.

The general structure of the survey, however, was the same for the three targets and can be divided in three sections (and ten parts): the profile of the participant, the relevant energy efficiency issues, and the feasibility of the measures. More specifically, parts 1-3 of the survey required the respondent to provide general and essential data, which would give the profile of the participant. Parts 4-7 focused on the current status and trends of the energy efficiency measures/schemes applied, and parts 8-10 aimed to identify the economical and organizational feasibility of the measures.

More specifically, Part 1: “Company identity” aims to assess general characteristics of the participating companies, such as the size and the sector of the industry. In Part 2: “Energy issues

awareness", the respondents are asked about their knowledge of energy issues in their own industry. The aim of part 2 is to quantify the share of the energy cost with respect to the total costs and to register current and future attitude towards energy efficiency. In Part 3: "Energy use", the actual consumption of energy is investigated, with reference to both the electrical and the thermal use.

The second section, Part 4: "Energy Efficiency approach" focuses more specifically on the energy efficiency domain. The execution of energy audits, the appointment of energy managers, the use of energy performance indicators within the company/organisation are some of the points of interest. Part 5: "Motivations towards Energy Efficiency measures" aims to know if a company has already implemented energy efficiency measures and the motivations behind this decision: was it obligatory or voluntary? What were they aiming to gain? Part 6: "Technical description of Energy Efficiency measures" investigates in which sector has industry invested in order to achieve energy efficiency and which solutions are deemed/assessed as the most useful and sustainable. Finally, Part 7 focuses on the "Level of satisfaction from implementation of EE measures": how did the companies evaluate their choices? Have the initial goals been achieved? What is the feedback of the results from the chosen solutions?

The third section focuses on managerial issues. Firstly, the economic feasibility of the investments in energy efficiency measures is examined in Part 8: the way companies financed the measures, as well as their future intention of financing similar measures. Which cost is considered a barrier and which a trigger? Then, in Part 9 a more detailed insight on the barriers is made, both economical as well as procedural, in order to identify the initiatives for future investments in energy efficiency. Finally, in Part 10 the organisational feasibility of energy efficiency measures was examined, aiming to facilitate the procedures and providing insights for policy makers and financial institutions.

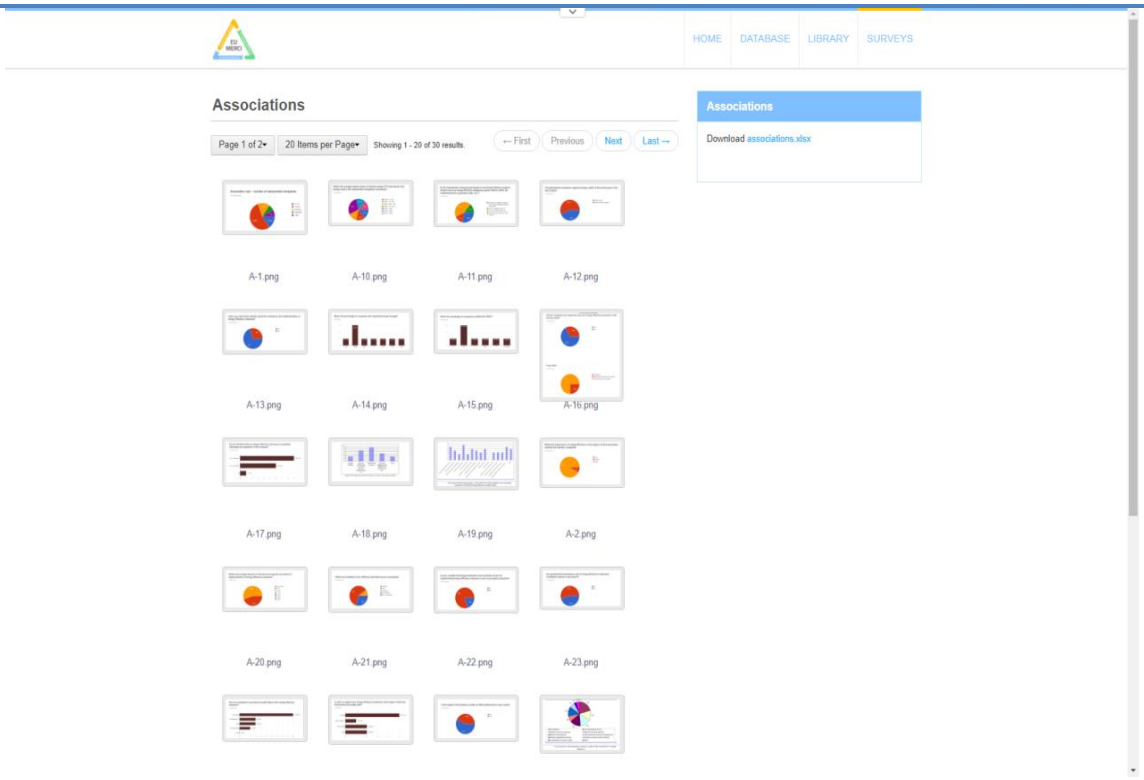
The majority of questions are identical across all three target - groups, but some questions are slightly altered to correspond with the characteristics of the group (industry, ESCO or trade association). The link to the questionnaires for the three target groups can be found in Annex 1.

1.5 The surveys on the European Industrial Energy Efficiency good Practices platform

A very important issue of the EUMERCI project is the dissemination and the availability of the results to the stakeholders and the relevant interested parties. In order to assure that, the results of the survey are available online, being uploaded to the EIEEP platform. The EIEEP platform has been created in the frame of the project, and there is a dedicated section on the main menu, called *surveys* (http://www.eumerci-portal.eu/web/guest/surveys) where all the answers from the bottom-up surveys on industrial companies, ESCOs and associations are published.

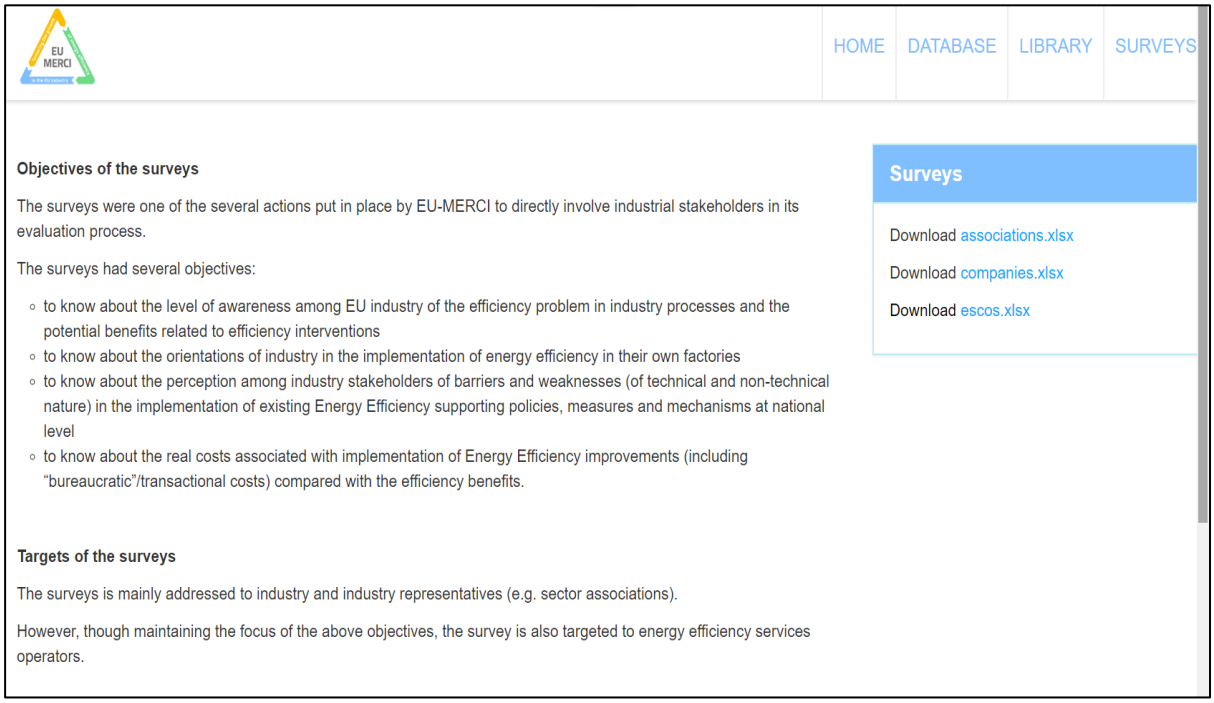
More, specifically, each page of every survey includes:

A. A downloadable excel file with each unique answer, listed, and cleared from any personal data.
B. An image gallery, paginated, with the statistical analysis, of every question, as reported by the google forms or by this report (Picture 1).



Picture 1: Image gallery at the platform

On the main page of this section, there is an overview of the task, explaining the objectives and the targets:



Picture 2: Main page of the survey's section at the platform

At the end of 2017, the portal gave the following statistics regarding the views on the respective pages and files:

- Companies Download companies.xlsx : 926 Views
- Associations Download associations.xlsx : 857 Views
- Escos Download escos.xlsx : 823 Views
- Objectives of the surveys: 435 Views

2 Market Analysis - Companies

The responses to the questionnaires by sector are presented in the following paragraphs. More than 130 completed questionnaires have been received. The participants were industrial companies coming from 9 different countries (Italy, Bulgaria, Romania, Slovenia, Netherlands, Poland, Greece, Czech Republic and the UK), while further contribution had been made from 15 ESCOs, and from 13 trade associations. The survey had a variety of participants from different sectors and size. Some sectors, however, like the ones related to the food products, showed more interest in contributing to the project.

The table below summarises the number of responses by NACE category.

Table 1: NACE code

Category (NACE code)	No of responses	
Manufacture of food products	19	NL (3), BG (2), CZ (5), GR (1), PL (3), RO (4)
Manufacture of rubber and plastic products	11	SI (1), RO (2), IT (3), GR (2), BG (3)
Manufacture of chemicals and chemical products	9	NL (5), IT (3), BG (1)
Manufacture of basic metals	6	IT (2), NL (1), PL (3)
Manufacture of beverages	6	GR (1), CZ (3), RO (1), UK (1)
Manufacture of paper and paper products	6	BG (2), NL (1), PL (1), RO (1) IT (1)
Manufacture of electrical equipment	6	SI (3), RO (2), BG (1)
Manufacture of machinery and equipment n.e.c.	6	BG (3), IT (2), RO (1)
Electricity, gas, steam and air conditioning supply	6	IT (5), SI (1)
Manufacture of basic pharmaceutical products and pharmaceutical preparations	5	IT (3), SI (2)
Water collection, treatment and supply	5	RO (1), IT (3), NL (1)

Architectural and engineering activities; technical testing and analysis	5	RO (2), IT (3)
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	4	BG (3), RO (1)
Manufacture of glass and glass products	4	IT (2), NL (1), PL (3)
Other mining and quarrying	4	SI (2), IT (1) NL(1)
Activities of head offices; management consultancy activities	4	IT (2), RO (1), SI (1)
Manufacture of fabricated metal products, except machinery and equipment	3	IT (2), RO (1)
Manufacture of motor vehicles, trailers and semi-trailers	3	IT (2), RO (1)
Extraction of crude petroleum and natural gas	2	RO (2)
Manufacture of wearing apparel	2	BG (2)
Manufacture of coke and refined petroleum products	2	RO (2)
Manufacture of computer, electronic and optical products	2	BG (1), IT (1)
Land transport and transport via pipelines	2	IT (1), RO (1)
Manufacture of furniture	1	RO (1)
Waste collection	1	IT (1)
Specialized construction activities	1	SI (1)
Warehousing and support activities for transportation	1	RO (1)
Telecommunications	1	IT (1)
Information service activities	1	IT (1)
Insurance, reinsurance and pension funding, except compulsory social security	1	RO (1)
Other manufacturing	1	IT (1)
Real estate activities	1	SI (1)
Legal and accounting activities	1	IT (1)
Other professional, scientific and technical activities	1	CZ (1)

As it can be seen in the table above, there has been a response from a variety of industry sectors, however, some of which had quite a few representatives. In order to conduct a deep and thorough analysis, the received questionnaires had been studied as a whole at first and then in a sector-specific categorization. The chosen sectors for this further analysis had been the *Manufacture of food products* and the *Manufacture of rubber and plastic products,* since these sectors had shown the biggest representation, hence, the most interest.

2.1 Company Profiles

In order to get a clear and complete image of the companies that participated in the survey, it was essential to gather some basic operational data concerning the identity of each company.

The organizations that participated in the survey were primarily medium to very large size companies, in equal percentages, as it is shown in Figure 1a. A company is defined medium sized when it has between 50 to 250 employees, while a very large company has more than 500 employees. Figure 1b shows the turnover of the companies. Most of the participants have a turnover between 10 to 50 million euros, while the smallest percentage (10.4%) has a turnover of more than 500 million euros.

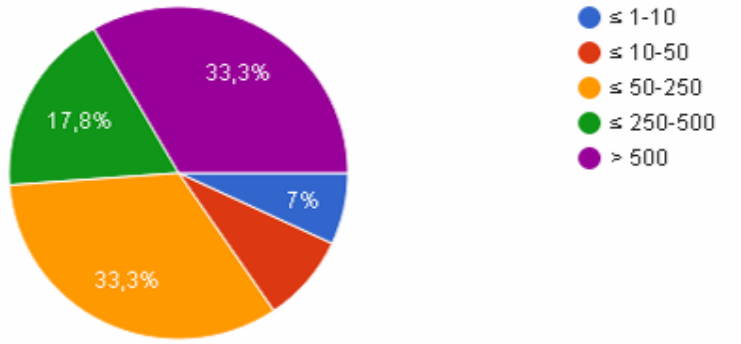


Figure 1a: Number of employees

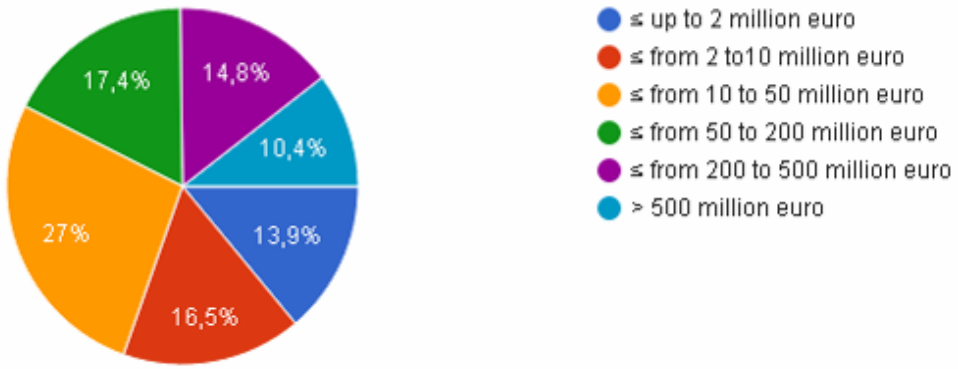


Figure 1b: Turnover class

In this section, the categorization has been done according to social and economic measures, which are not to be taken into account for the further analysis related to the energy management and efficiency issue.

2.2 Energy issue awareness

This section aims to identify the level of energy awareness amongst the responding companies. In order to achieve this, companies were first asked to what extent energy issues are priorities for them. This question gave an insight into the attitude of the management towards energy consumption and the current status towards this issue as well as the scopes for further integration.

The questionnaire asked companies to state their level of awareness according to four different levels from zero level ("no awareness") to the highest possible level, which is not only to consider energy issue as an important factor for the management of the company, but, furthermore, to have completely integrated the concept of energy efficiency within the company's policies and targets. In between, the levels of awareness ranged from scarce importance through to energy issues only being important at top management level.

As can be seen in Figure 2, the vast majority of questionnaire participants claim to have completely integrated energy efficiency within their company's policies and targets. Furthermore, the second largest group of questionnaire participants has also integrated energy issues within their policies and targets, but only at the top management level. None of the participating industries replied that there is no awareness of energy issues in their sector, demonstrating that the vast majority of European industry has a high level of awareness and integration of energy efficiency in their companies.

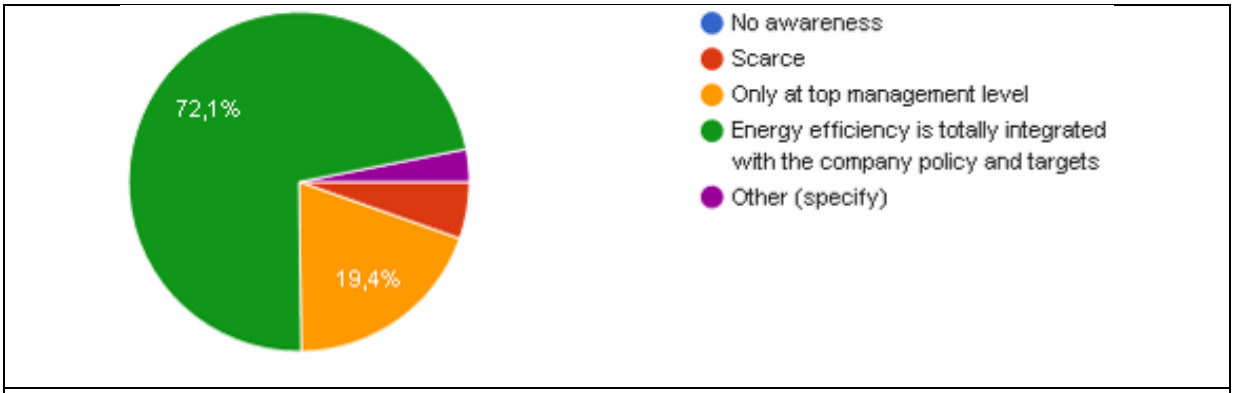


Figure 2: Awareness of companies with respect to the energy issue

Further analysis of the data has shown that companies with yearly overall energy consumption of more than 10.000 TOE/year present the highest percentage of awareness, since the 85% of those have stated that the energy efficiency is totally integrated with the company's policy and targets. The 75% of the companies with yearly overall energy consumption of less than 1.000 TOE/year have integrated EE in their policy and targets, which is quite similar percentage (72%) with the companies with yearly overall energy consumption of less than 10.000 TOE/year and with the companies with yearly overall energy consumption of less than 100 TOE/year (71% have totally integrated EE in their

policy and targets). The companies with a consumption of less than 500 TOE/year have been proven to be the less aware on this issue, since only the 60% has integrated EE in the company policy and targets.

Specific analysis respecting the company size

A further analysis has been made to this sector, gathering all the size categories in one Figure. In this categorization, the companies that are consuming less than 10.000 TOE/year are presenting the numerical advantage on energy efficiency integration, followed by the companies that have energy consumption higher than 10.000 TOE/year.

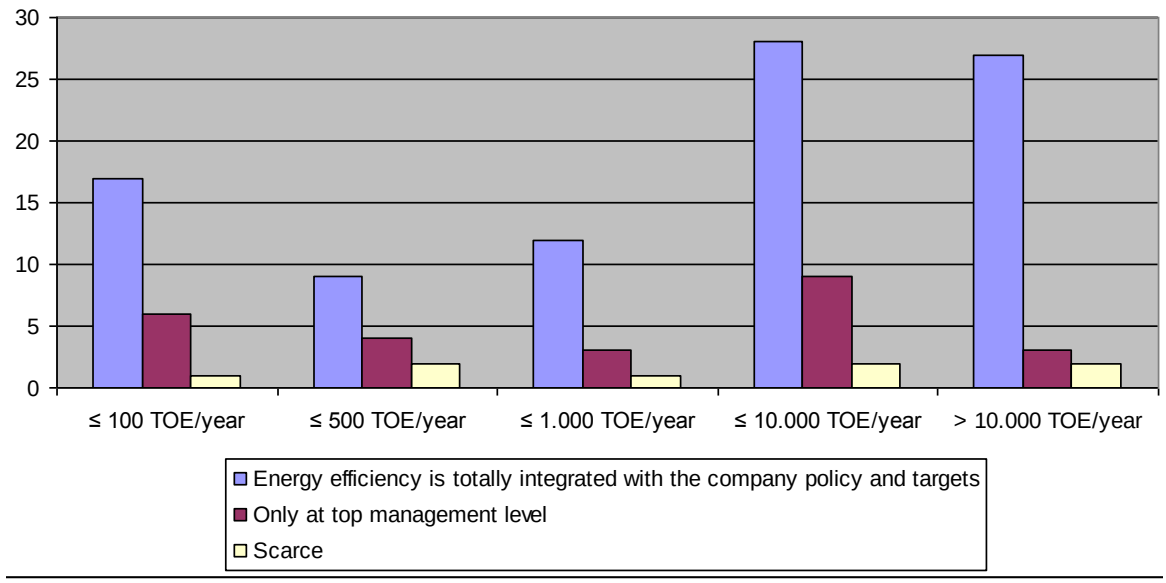


Figure 3: Overall awareness of companies by yearly overall energy consumption (100TOE= 1,16 GWh)

The next issue examined was more technical. Responders were asked to state energy costs as a percentage of the turnover for their company. This was useful in order to enhance the understanding of how energy intensive each company was, as well as to gain an insight into the importance of energy costs against their whole cost base. As it can be seen in Figure 4, for most of the participating companies the energy costs are 2-10% of their turnover, hence of medium level. The companies with low energy consumption (<2%) make up the second largest group of the participants, followed by the group of high energy-consumers (>10%).

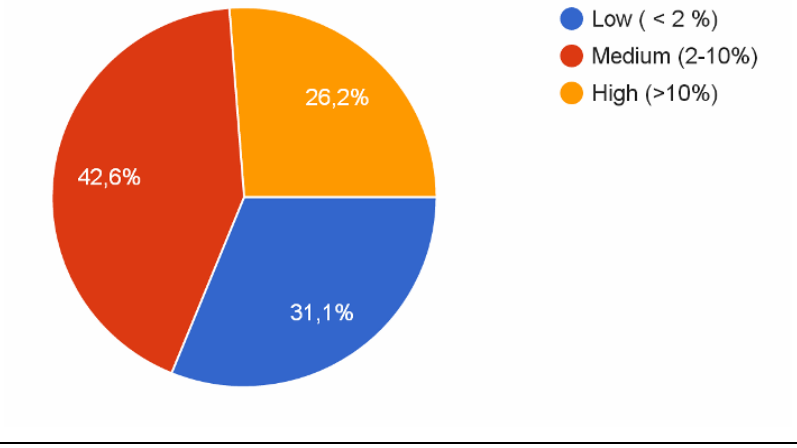


Figure 4: Incidence of the energy costs as a percentage of turnover

Specific analysis respecting the company size

A further analysis has been made in order to identify the energy costs as a percentage of turnovers depending on the size of the industry. The results are presented in the following figure. It can be noticed that the majority (61%) of the smallest companies (≤ 100 TOE/year) have indicated that the incidence of energy cost as a percentage of the turn- over is of low importance and the majority (42%) of the biggest ones (>10.000 TOE/year) have characterized the incidence as high. In the other climaxes, the incidence is mainly characterized as of medium importance, except the industries of less than 1.000TOE/year, which have valued their incidence almost equally as low, medium and high.

The above detailed results are gathered in the following figure, in order to enhance the comparison of the incidence of energy costs of each industry size.

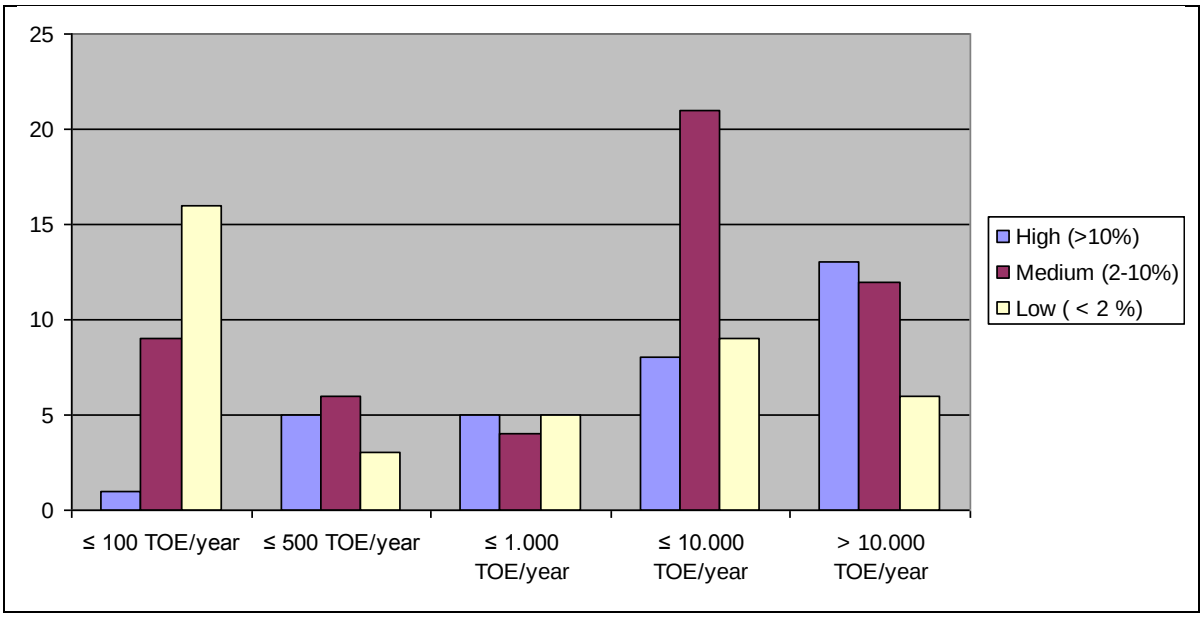


Figure 5: Incidence of the energy costs as a percentage of turnover- further analysis to the company size

The last question of this section concerned the opportunities that the companies see for energy efficiency measures, aiming to achieve a reduction to their energy costs. Indeed, the vast majority of companies consider that energy efficiency can reduce their energy costs by 5-10%, which is a reasonably achievable target for most companies.

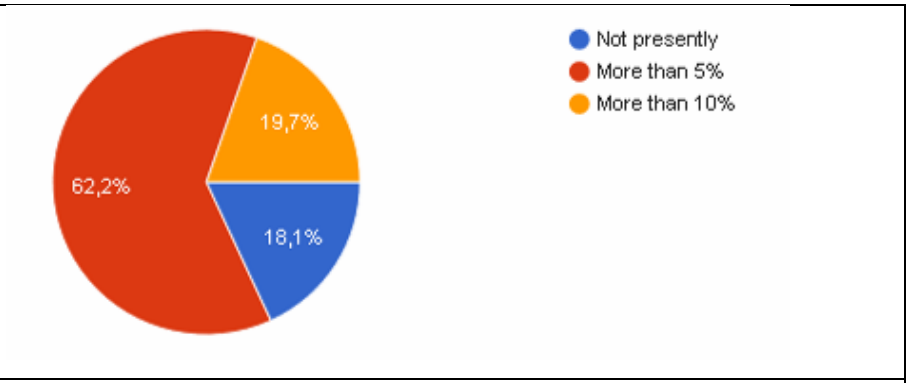


Figure 6: Belief that there may be a reduction of the energy costs by improving energy efficiency

In conclusion, most of the participating industries were in a very good position with respect to the energy issues of their company. They have already realized the importance of the integration of energy management in their policy, monitoring and targets, and they can see an improvement of their performance coming from the implementation of energy efficiency measures.

Specific analysis respecting the company size

A further analysis has been made according to the company's size and their belief on the possibility of energy costs after implementing energy efficiency measures, and the detailed results are presented in Figure 7. As it can be noticed, all the companies have indicated that it is possible to achieve an energy reduction of more than 5%. The biggest companies (of more than 10.000TEO/year) present the highest value concerning a higher reduction (more than 10%).

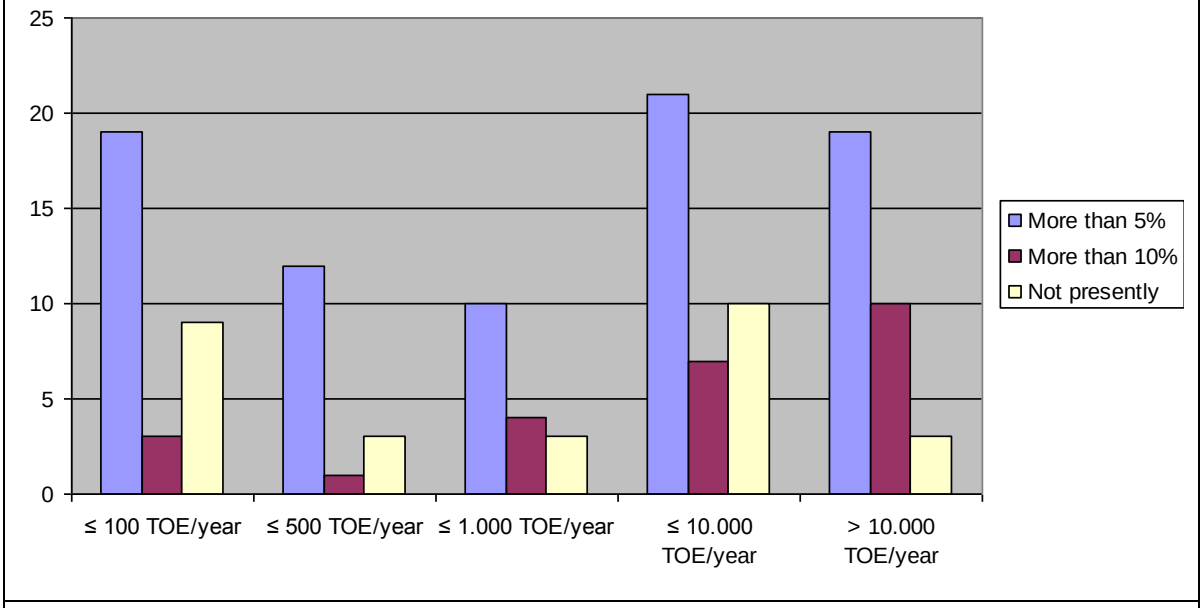


Figure 7: Belief that there may be a reduction of the energy costs by improving energy efficiency, by company's size (by yearly overall energy consumption (100TOE= 1,16 GWh))

2.3 Energy use

This section aims to map the energy use of the companies participating in the survey, meaning the level of consumption, energy's distribution in the companies' activities, energy independence etc. In order to achieve this target, the questionnaire asked five questions, starting with a question on the level of total energy and more specifically, electricity consumption.

As demonstrated in Figure 8, most of the companies that participated in the questionnaire have a total energy consumption between 1.000 and 10.000 TOE/year (where 100 TOE=1.16 GWh). The second largest group of companies has an even larger energy consumption of more than 10.000TOE/ year, and the third biggest group consumes less than 100TOE/ year.

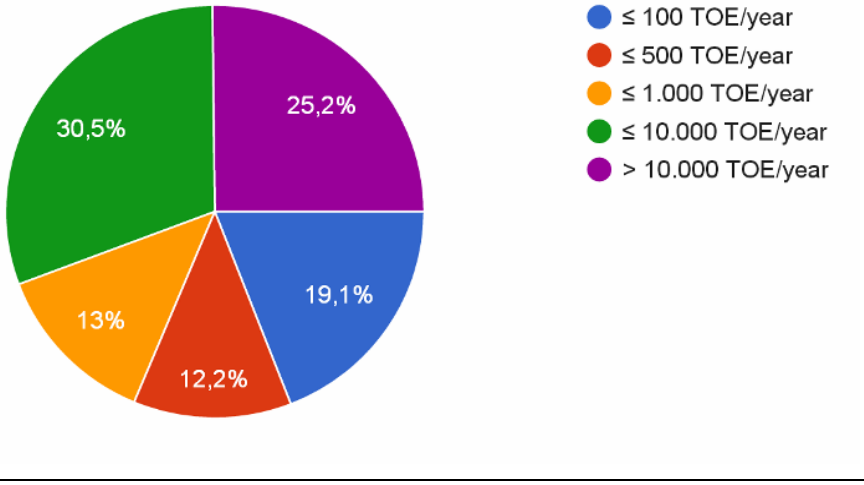


Figure 8: Overall energy consumption of the participating companies

As far as it concerns the electricity consumption (see Figure 9), most companies (34.6%) consume a large amount of electricity (between 1.000 and 10.000 TOE/year), followed by 20.8% of companies that consume a small amount of electricity (less than 100 TOE/year) while 18.5% consume between 100 and 500TOE/year of electricity. Companies which consume a very large amount of electricity are the smallest group of participating companies (11.5%).

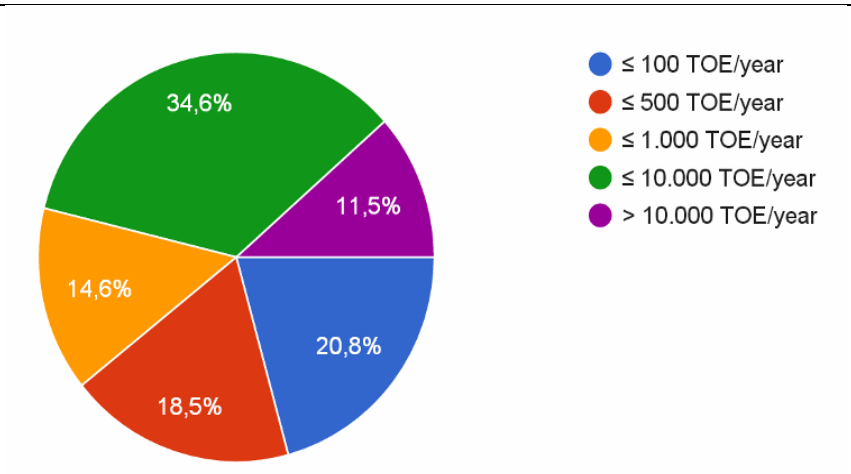


Figure 9: Overall electricity consumption of the participating companies

The electricity consumption of participating companies was further analyzed by asking about the most electricity intensive technologies within their industrial processes and buildings. As can be seen in Figure 10, pumps are by far the largest consumers of electricity. Other technologies identified to consume a significant amount of electricity, were fans and electricity for heating. Lighting, on the other hand, is not a major consumer of electricity in these companies. This could be related to the sectors in which the companies that have responded to the questionnaire are in (see also NACE analysis).

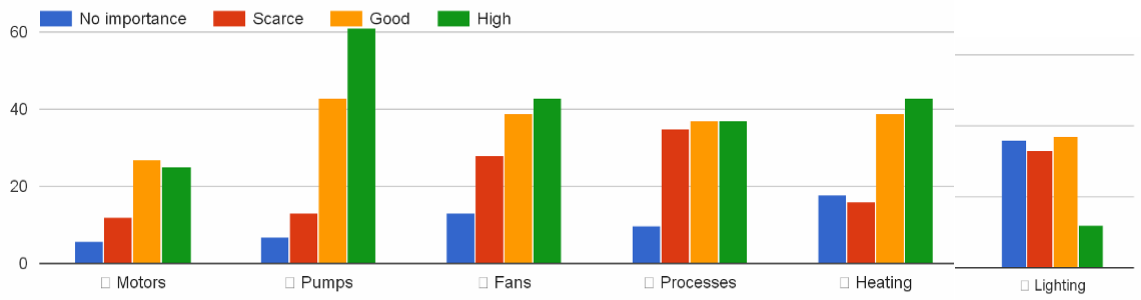


Figure 10: Importance of the electricity consumption for each technology

Specific analysis respective to sectors

As it can be seen in the following figure, the above results represent the average of the industry. In a more detailed analysis, the food sector (see next figure) seems to consume more electricity for the motors, while the least important sector is the processes.

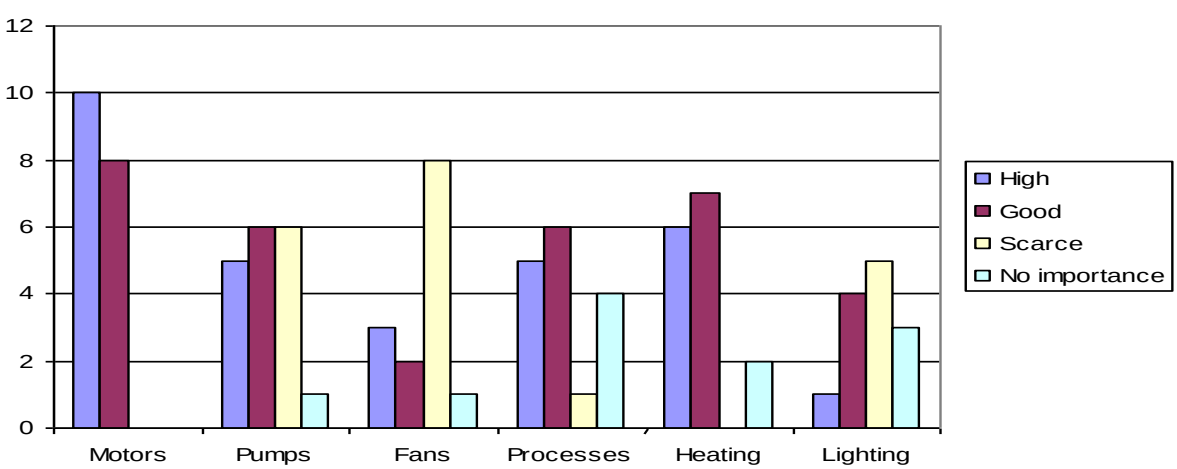


Figure 11: Importance of the electricity consumption for each technology in the food industry

Similar results have occurred by the analysis of the results of the rubber sector, since again the motors are consuming the most electricity. However, in that case, it seems that processes and heating are equally of no importance.

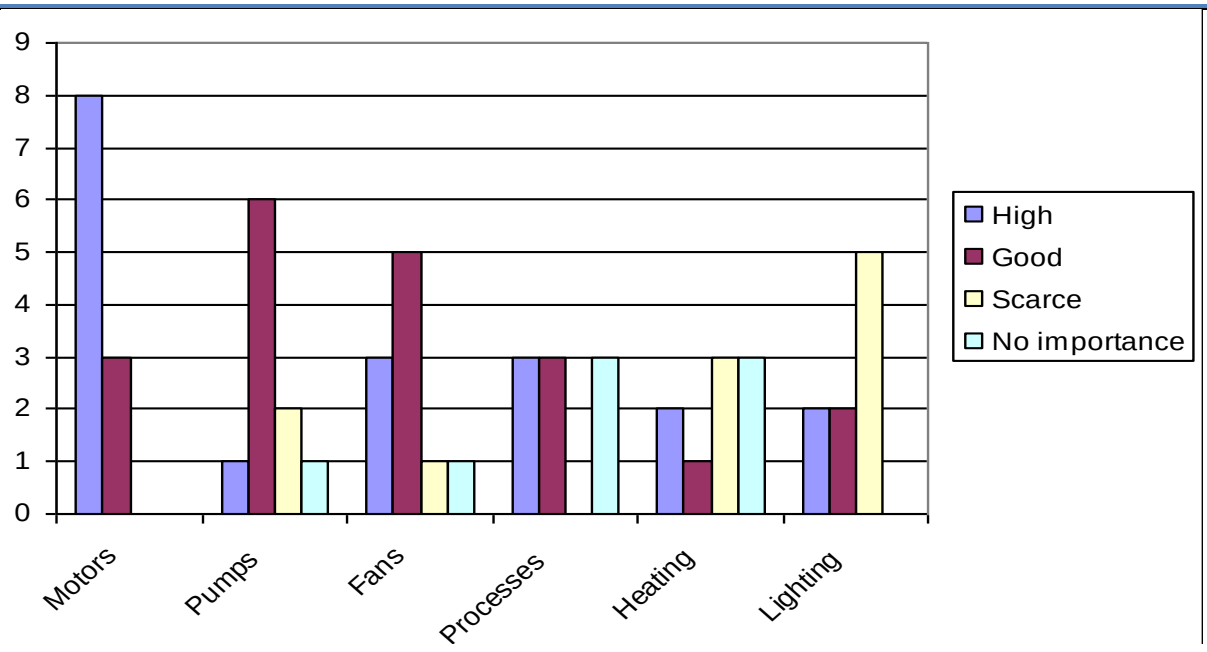


Figure 12: Importance of the electricity consumption for each technology in the rubber industry

Specific analysis respective to size and technology

For a more detailed observation of the electrical consumption on the European industry, a further analysis has been made, focusing to the relation of consumption in each sector with the size of the company.

As it can be seen in the following figure, the consumption of electricity for the Motors is considered to be of high importance for all industry sizes but the ones less than 100 TOE/yr, where is characterized as of good importance. In that industry size category (less than 100TOE/yr) can also be noticed the biggest number of companies which had valorized the energy for motors as of “no importance” or “scarce” (see yellow and light blue columns), while in the other categories these columns are quite low.

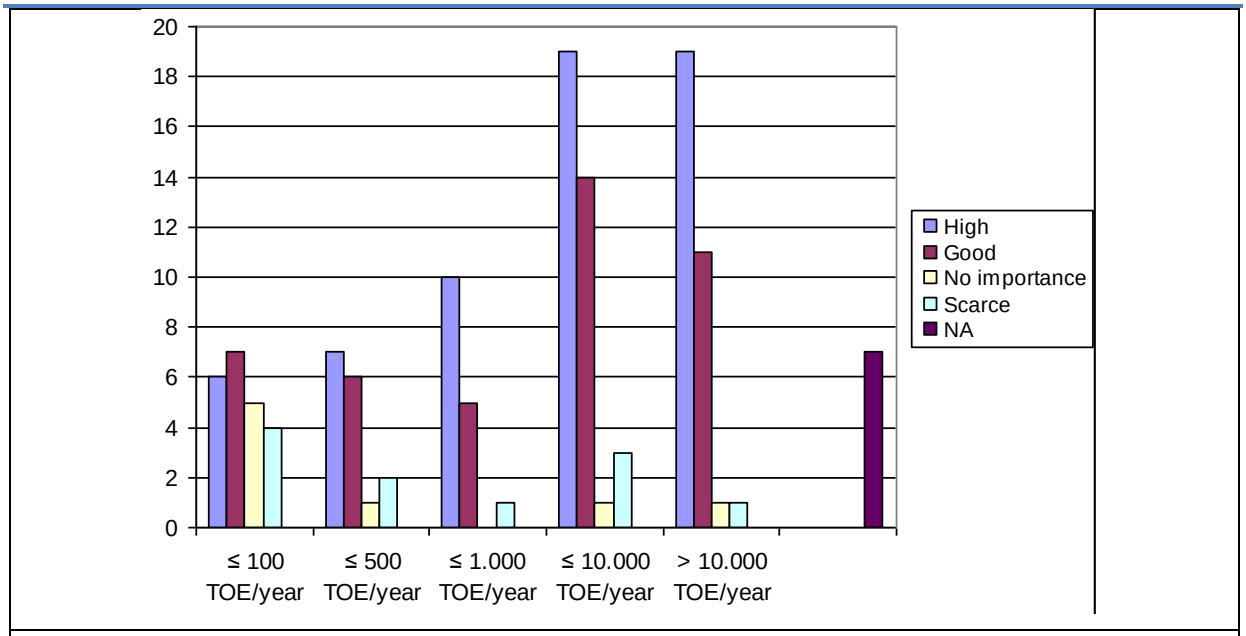


Figure 13: Importance of the electricity consumption for Motors, in relation to the size of the companies

When it comes to Pumps, the results vary for each category: most companies of less than 100/TOE/yr valorize their electrical consumption as of no importance, while most of the companies of less than 500TOE/yr, less than 1.000TOE/yr and more than 10.000 TOE/yr as of high importance. Only companies of less than 10.000 TOE/yr valorize the consumption of pumps to be as of good importance. It is also interesting to notice that in the same category the number of companies that consider the importance of electric consumption of the pumps to be "High" and "Scarce" are quite similar (see blue and purple column), while in the category of more than 10.000TOE/yr the companies which noticed the importance as "Good" and "Scarce" is exactly equal (see red and purple column).

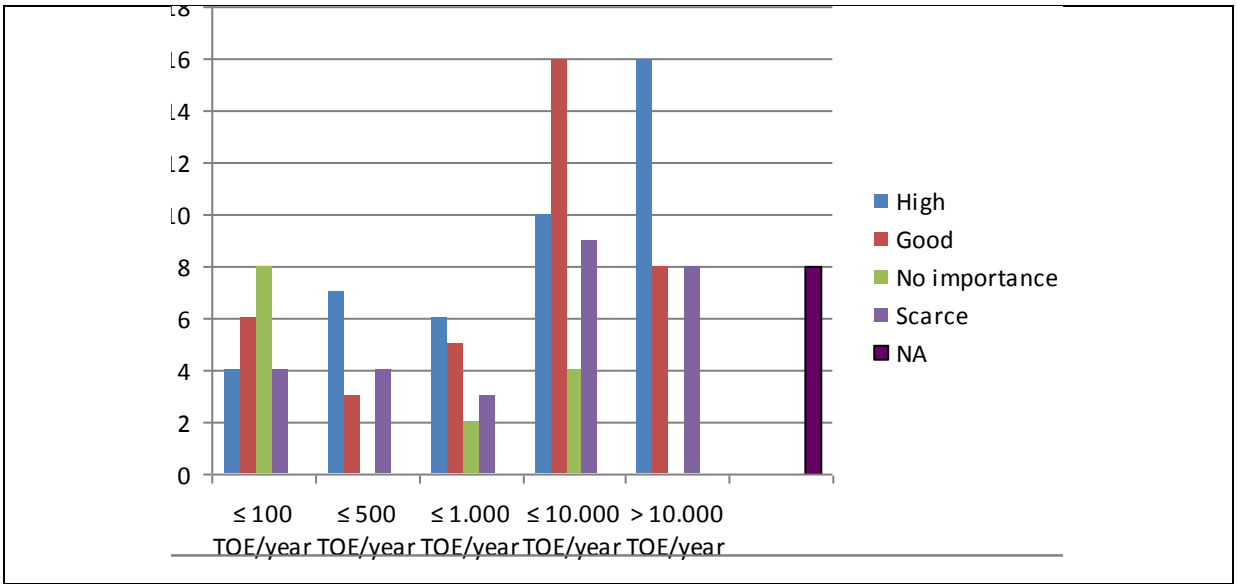


Figure 14: Importance of the electricity consumption for Pumps, in relation to the size of the companies

Fans are most important for the larger industries (more than 10.000TOE/yr) and the least important for the companies of less than 10.000TOE/yr. For the smallest companies (of less than 100TOE/yr) most of the columns representing the companies' valorization are the same. It can be concluded that the consumption for fans- especially at the small industries- depends a lot from the kind of production each company has.

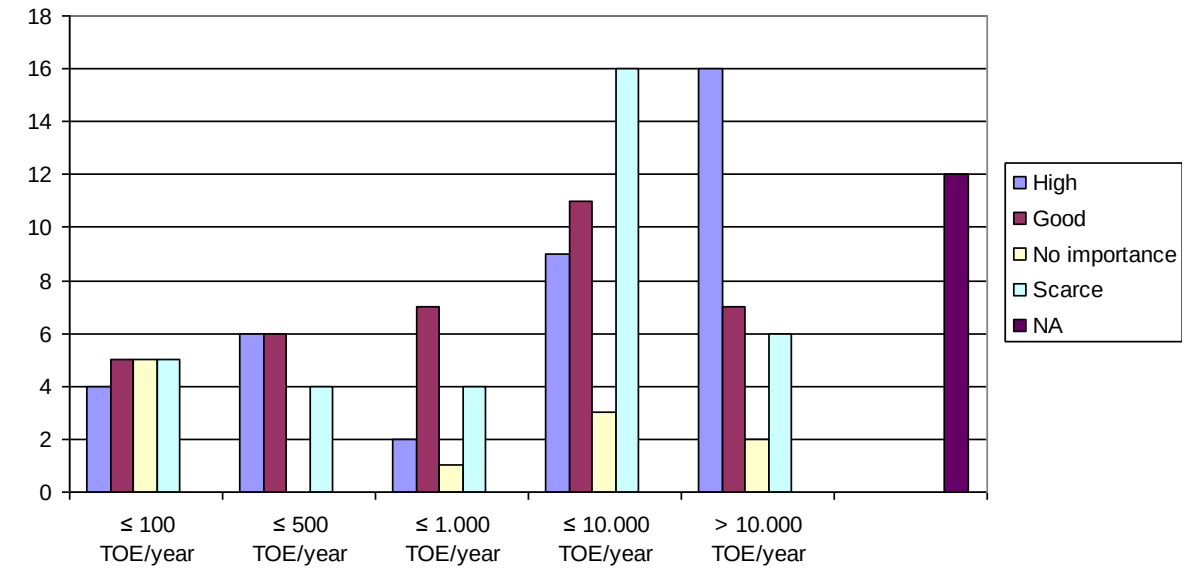


Figure 15: Importance of the electricity consumption for Fans, in relation to the size of the companies

Companies of less than 10.000TOE/yr consider the electricity they consume for the processes equally to be of "Good" or "No importance". Equal valorization also appears to the companies of less than 1000TOE/yr, between "high" and "good" this time, concluding that is a quite important issue for the majority of them. Companies which are consuming less than 500TOE/yr as well as more than 10000TOE/yr have valorized the importance of electricity consumption for processes to be of high importance.

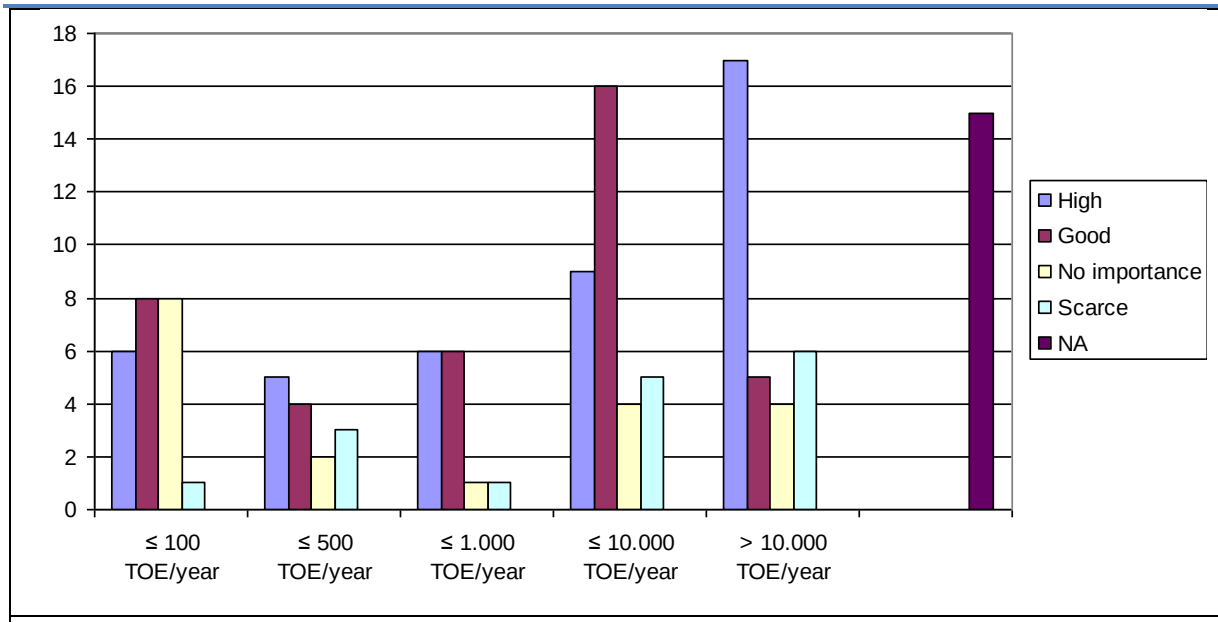


Figure 16: Importance of the electricity consumption for processes, in relation to the size of the companies

Heating is not considered to be the most important electric consumer for none of the industries' categories. Most of the smaller ones have valorized the consumption for heating as of Good importance, and is the most homogenized valorization in this category. This could be an interesting conclusion regarding the electric consumption in relation to the company size: for all the other factor, the valorization of small industries depends a lot from the kind of production except the heating needs, where are massively appreciated as of Good importance. Similar conclusions can also be drawn from Figure 18 concerning the Lighting, although the difference between the columns (for the companies of less than 100TOE/yr) is not so massive. Regarding the companies of less than 1000TOE/yr the results of the survey concerning the valorization of their electricity consumption for heating are quite similar, since almost all values have equal answers.

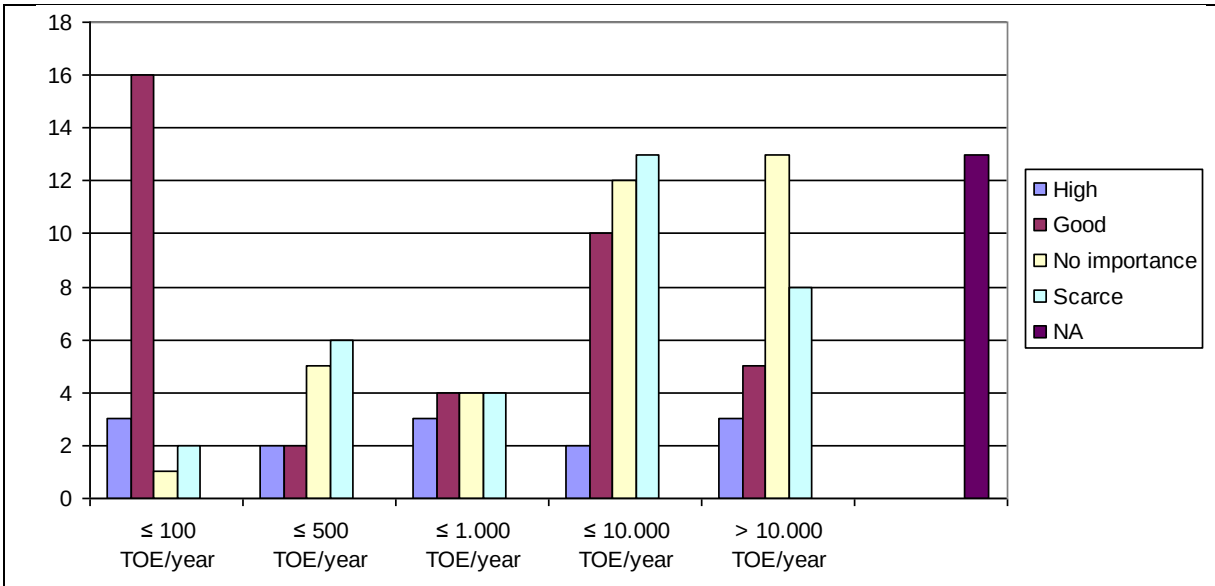


Figure 17: Importance of the electricity consumption for Heating, in relation to the size of the companies

Lighting in general is not considered an important electricity consumption domain for all the other categories of industries. Only the majority of companies of less than 100 TOE/yr has considered their lighting consumption as “good”, the others valorized it as “scarce”.

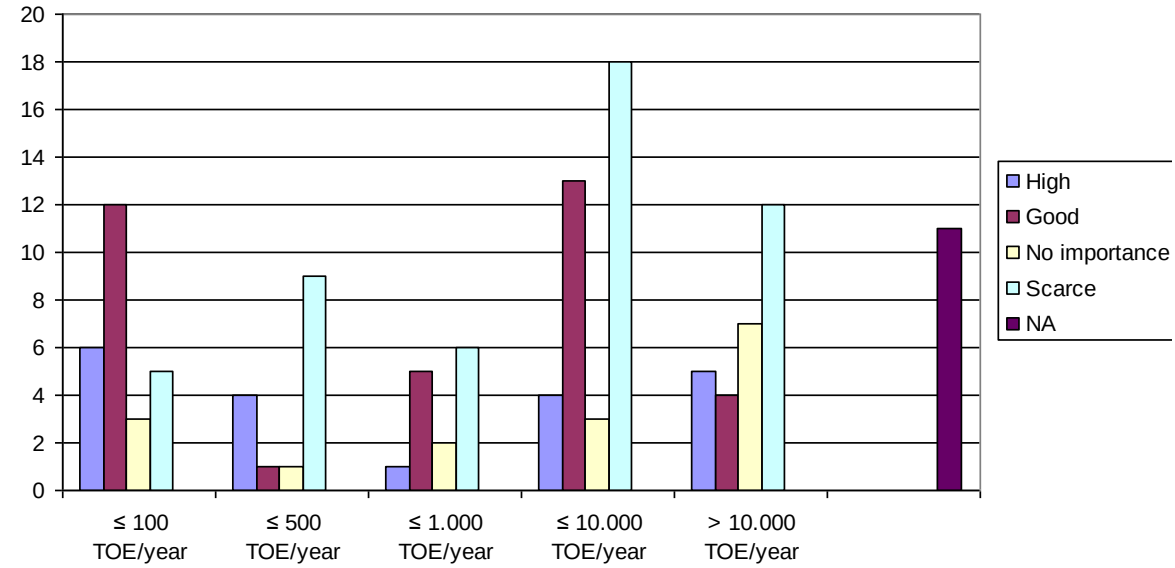


Figure 18: Importance of the electricity consumption for Lighting, in relation to the size of the companies

To have a better view of the energy consumption, the survey registered the consumption of thermal energy as a percentage of electricity consumption. As can be seen in Figure 19, most of companies have the smallest proposed consumption of thermal energy as a percentage of electricity (0-25%), followed by the next climax of 25-50%.

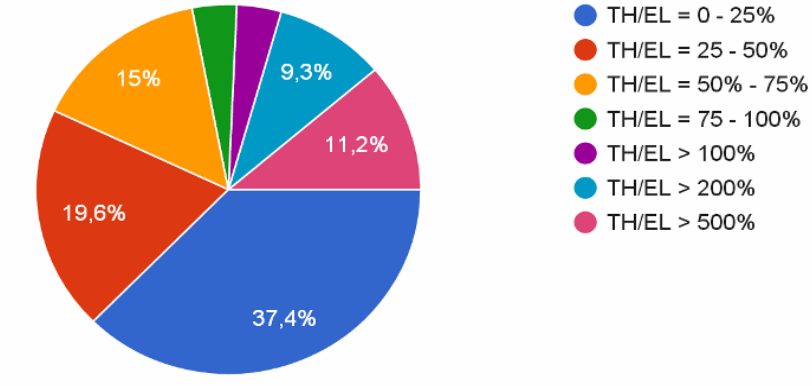


Figure 19: The energy incidence of the thermal uses with respect to the electricity uses, in the company processes

Finally, a less technical question asked about the presence of an energy production system to determine to what extent the responding companies are energy independent. As is evident from Figure 20, there is an almost equal share of companies that do not have a self- production energy system and companies that in one way or another do consume their own-produced energy. Companies with an energy production system were asked to identify the type of system (i.e. cogeneration, electricity or thermal production). The most common energy production system was cogeneration, followed by electricity and then thermal energy production systems.

In a more specific analysis, it was shown that all the industries which are having separate self-production energy systems are large (overall energy consumption> 10.000 TOE/year). The vast majority of industries having cogeneration system are having overall energy consumption ≤ 1.000 TOE/year, while only he 7% of the companies which are having cogeneration system are larger (overall energy consumption≤ 10.000 TOE/year). However, the 32% of companies of this category have not revealed their energy consumption size.

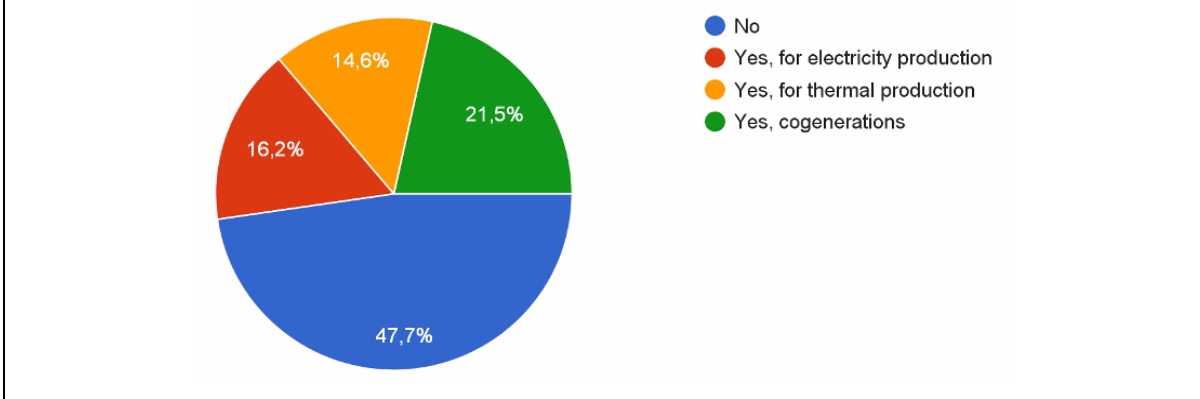


Figure 20: Presence of self-production energy systems

The 60% of the industries that do not have a self-production energy system are consuming less than 10.000 TOE/year, while the 29% less than 100 TOE/year. The 11% of the industries without a self-production system have not indicated their energy consumption.

2.4 Energy Efficiency strategy

This section summarizes the strategies which participated companies use to conduct and record their energy efficient measures, as well as assesses the trust they have in existing schemes and whether they have participated in any of them.

As demonstrated in Figure 21, most of the companies that participated in the survey have participated in one way or another in a support scheme, such as, the white certificates, other EE schemes or other type of support schemes.

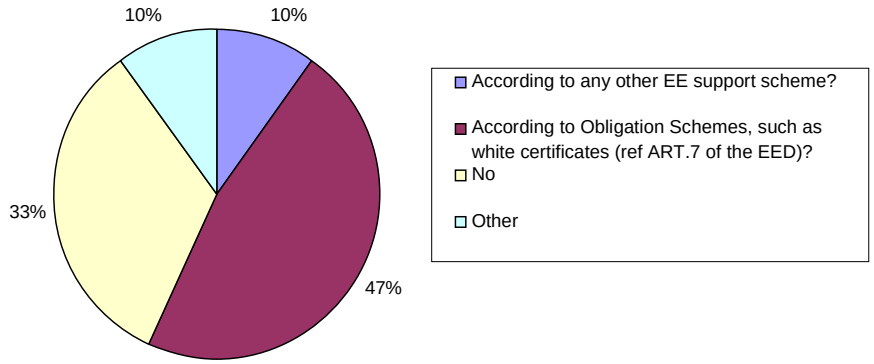


Figure 21: Participation in Energy Efficiency support schemes

Of those which have participated in energy efficiency obligation schemes, 62% have participated voluntarily and 38% as an obligated party. In the following figure it can be seen a further analysis of these companies (obligates parties) in relation to the country of origin. This can be in relation to the energy efficiency policy each country has applied (for further analysis, also see Chapter 5).

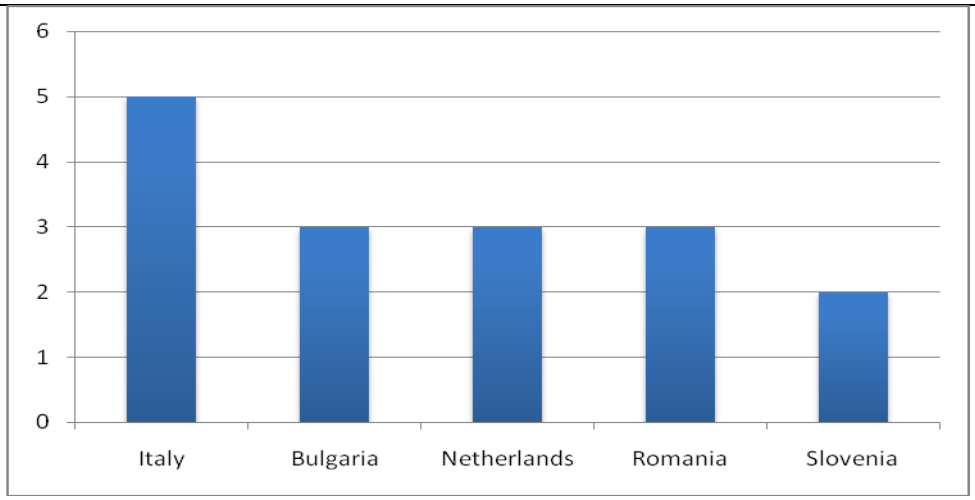


Figure 22: Origin of industries having participated to EEOS as obligated parties

However, a significant share of companies (33%) has designed their energy efficiency policy without any scheme support.

A useful tool for designing an energy efficiency policy is the conduction of an energy audit, in order to assess the current situation, set feasible targets and identify appropriate energy efficiency measures. As can be seen in Figure 23, most of the industries are aware of energy audits and support its implementation, either by conducting internal audits or by consulting an external expert. The majority of participants in this questionnaire conducted an energy audit using an external expert.

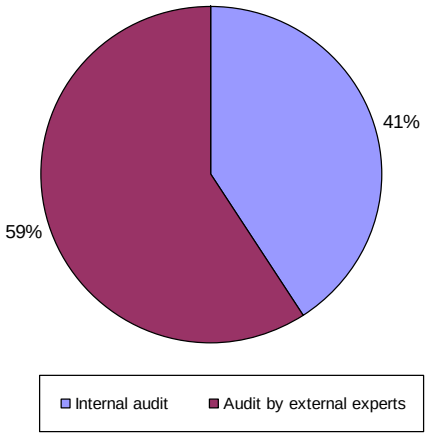
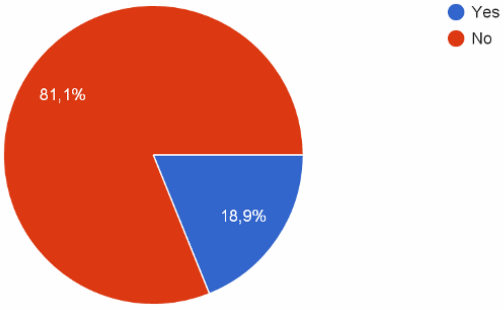
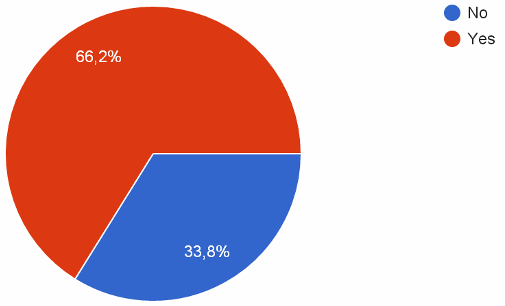


Figure 23: Conducted energy audits of the processes in the last 5 years

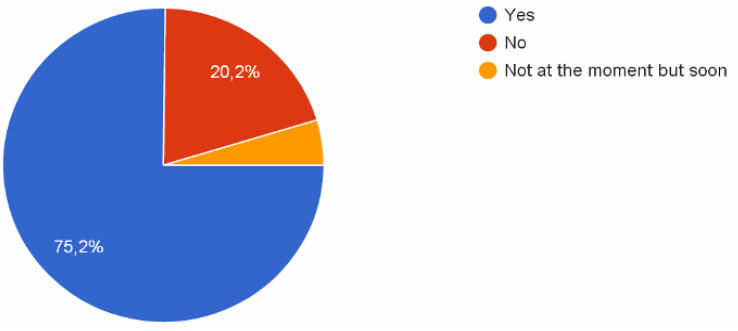
As demonstrated in Figure 24, most of companies that have participated in the questionnaire already have a well-structured approach towards managing, monitoring and auditing their energy consumption. More specifically, the vast majority of companies is not certified to ISO 50001, but has identified energy performance indicators and has appointed an energy manager. All these initiatives contribute to a targeted approach towards energy efficiency: the energy manager of the company can gather the relevant information, study the indicators, combine the results and make decisions which will lead to the reduction of energy consumption in an efficient way.



(a): Companies certified to ISO 50001



(b): Use of Energy Performance Indicators



(c): Companies that have appointed an energy manager

Figure 24: Managerial approach on energy efficiency

In the following figure, further analysis is done, where the lack of organized energy management is shown in relation to the company size. The smaller companies (<100 and <500 TOE/year) are not using energy managers or energy performance indicators.

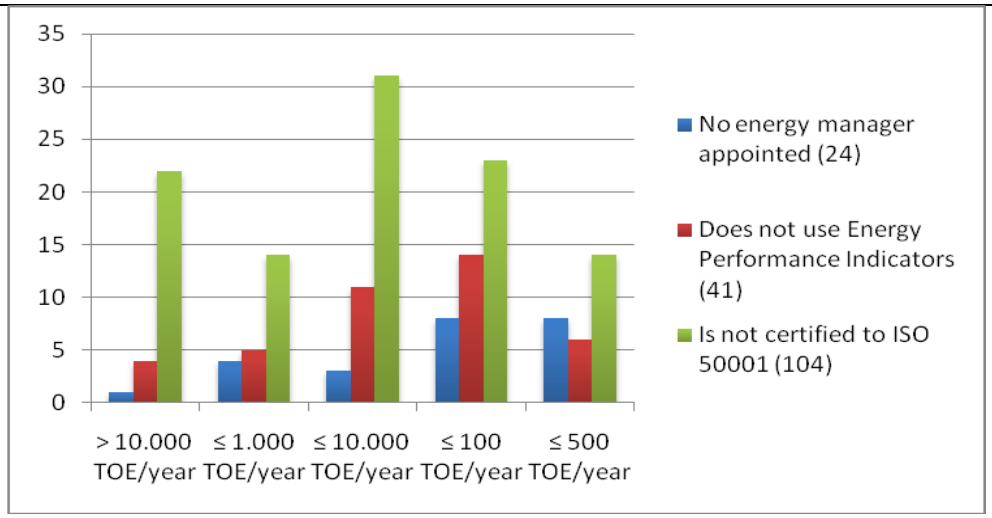


Figure 25: Analysis of industries without energy management in relation to the company's size (the number in the parenthesis are the number of responses, different for each question)

The results of the questionnaire show that the ways of managing a company towards energy efficiency are well known and appreciated in the industrial sector. 70-80% of the answers in this section of the survey indicate that companies are not only aware of the benefits of integrating energy management into the company's processes but are actually implementing their efficiency strategies even if the majority does not use of well-established and recognized standards (like ISO).

2.5 Motivations towards Energy Efficiency measures

Most of companies have already carried out energy efficiency measures over the last five years. The main reason for not having implemented any measures was economic inconvenience followed by a lack of interest and other unidentified reasons. The majority of companies, which have carried out energy efficiency measures cite a reduction in energy costs as the main objective. A significant number of companies saw energy efficiency measures as a mean to reduce production costs, while another important share of companies implemented energy efficiency measures to improve their core business attractiveness by enhancing the sustainability aspect of their products and/ or services, manufacturing process and value chain.

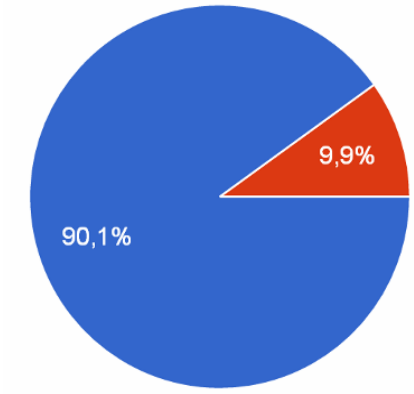
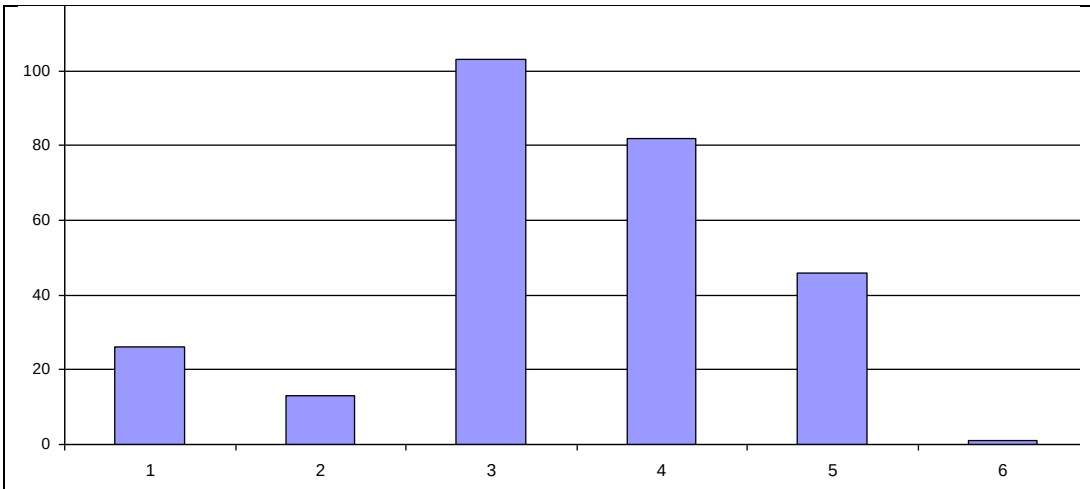


Figure 26: Percentage of companies carried out energy efficiency measures in the last five years.

Bleu: YES, Red: NO



1: Ageing of the equipment
2:Legal obligations
3: Reduction of energy costs
4: Reduction of production costs
5: Improvement of the core business attractiveness through an enhanced sustainability of the products/services, manufacturing process and value chain
6: Other

Figure 27: Main motivation for investing in energy efficiency

In addition to practical and economic reasons, which are encouraging the implementation of energy efficiency measures, there are also marketing and social factors which can contribute towards such a decision. The results of the questionnaire demonstrate that the majority of companies believe that the implementation of energy efficiency measures could make them more competitive, both by achieving a reduction in their selling price and by increasing the reputation of their company, by using efficiency as a marketing tool and gaining social preference of the consumers/ buyers/ target group.

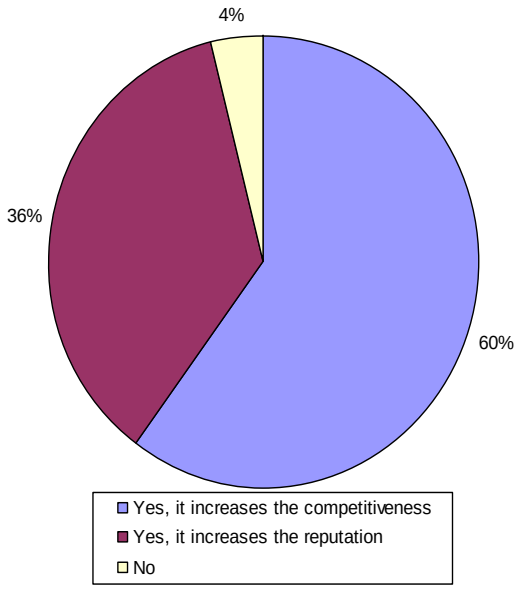


Figure 28: Impact of action on energy efficiency as a competitive advantage and reputation of the company

2.6 Technical description of EE measures

This section aims to identify the most popular energy efficiency measures implemented by the participating companies. First, the best-chosen sector of the operational procedure had been defined, and then the survey tried to identify more specifically the adopted solutions, by proposing fifteen options to the respondents where energy efficiency measures can be implemented. These options were examined in two ways: firstly the preference of participating companies was examined and secondly they evaluated the performance of reducing energy consumption as high, medium or low importance.

The results show that most companies chose to implement measures in the manufacturing process, while fewer companies invested in changes to their services & infrastructures (e.g. internal transport, lighting). Even fewer companies chose to implement energy efficiency measures to their buildings and the least popular choice of energy efficiency measures were measures applied to the management and organization of production and work.

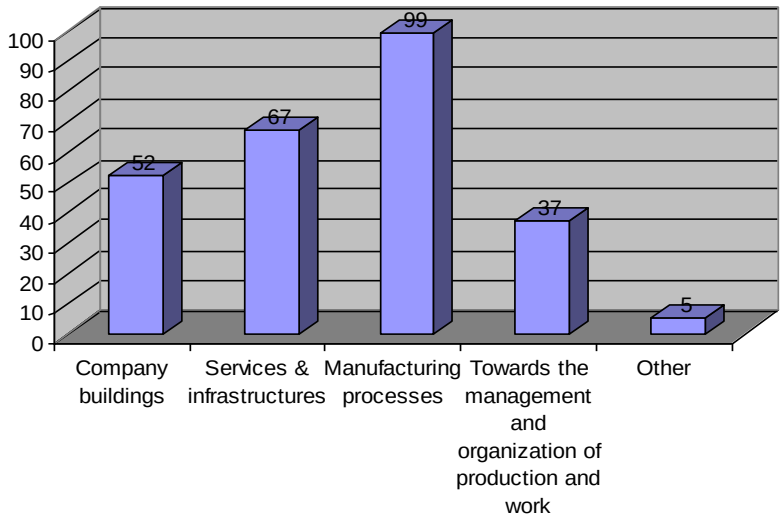


Figure 29: Energy efficiency measures carried out to reduce energy consumption

More specifically, the most popular adapted solution for the manufacturing process was the use of inverters (VSD systems), which was identified to be the most effective and economically sustainable choice. The next most common implemented solutions are the use of high efficiency electric motors and the implementation of energy management systems (PLC, automation). However, when asking companies about the importance of different solutions (see Figure 31), more companies perceived the implementation of energy management systems to be more important than the use of high efficiency electric motors.

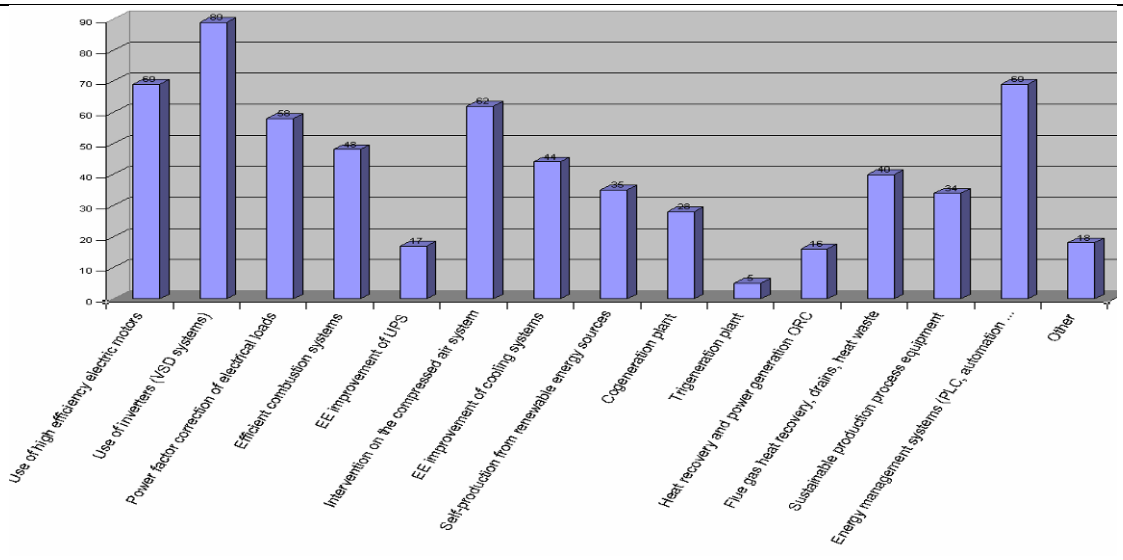


Figure 30: Adopted solutions in companies in the field of energy efficiency*[1]

[1]The choices of energy efficiency measures that respondents could choose from for this question were, in order of appearance: *Use of high efficiency electric motors, Use of inverters (VSD systems), Power factor correction of electrical loads, Efficient combustion systems, EE improvement of UPS, Intervention on the compressed air*

Hence, by combining the results presented in Figures 30 and 31, it can be concluded that the most popular and effective solution was the use of inverters, followed by the implementation of energy management systems and then by the use of high efficiency electric motors. Furthermore, the least useful and economic sustainable choice, according to the respondents of the questionnaire, was the installation of a tri-generation plant. It should be noticed that the results shown in Figure 30 and 31 come from multiple-choice questions. The participating companies also had the option to list other useful measures and the vast majority of responding companies listed improvements in lighting, more specifically the replacement of existing lighting with LEDs.

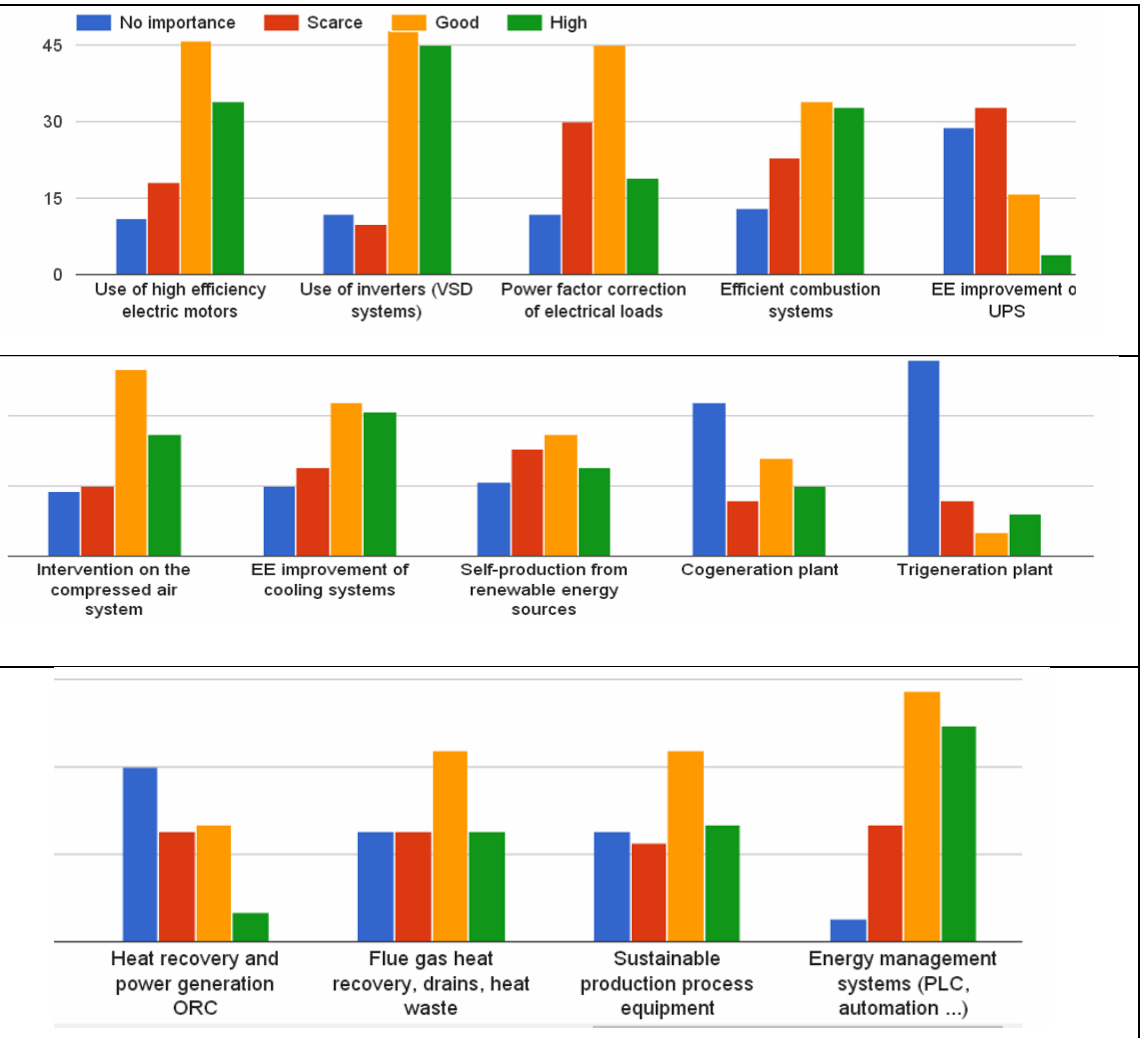


Figure 31: The most useful and economically sustainable solutions for the companies

system, EE improvement of cooling systems, Self-production from renewable energy sources, Cogeneration plant, Tri-generation plant, Heat recovery and power generation ORC, Flue gas heat recovery, drains, heat waste, Sustainable production process equipment, Energy management systems (PLC, automation ...), Other.

2.7 Level of satisfaction from the implementation of EE measures

This section highlights the outcomes- including energy savings- that companies have observed from the implementation of energy efficiency measures. The majority of companies have achieved a reduction that is less than 5% of their annual energy bill and 27.2% of companies have achieved a reduction less than 10%. The remaining companies (31.2%) observed reductions varying from 15% to 30% of their total annual energy bill, did not record their results, or observed no reduction in their energy usage.

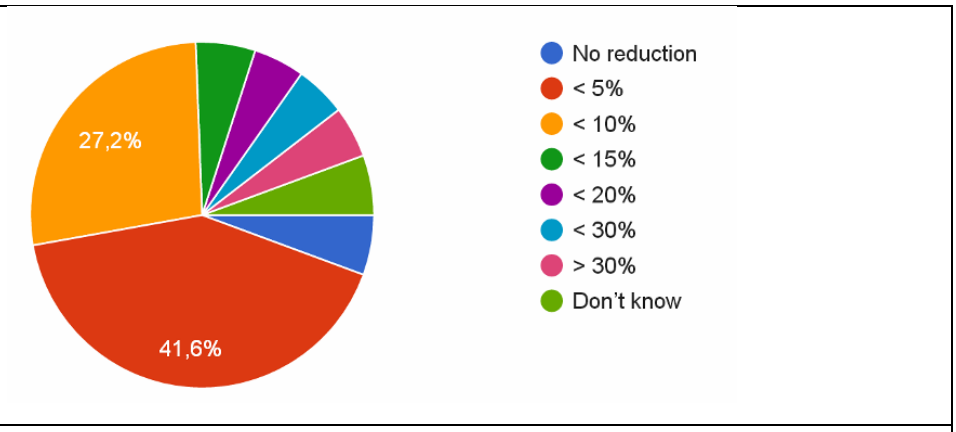


Figure 32: Reduction in the annual energy bill due to the intervention on energy efficiency

The vast majority of the companies have declared that they are satisfied with the implementation of the energy efficiency measures, evaluating the achievement of their initial goals from partially (less or more than the 50% of their initial expectations) to fully achieved and satisfied. This result is reflected by the feedbacks to the next question of the survey, which asks about the overall level of satisfaction from the path to the efficiency taken by the company. Most of the replies, which are presented in Figure 33, indicated a good feedback, whilst 16.9% of participants indicated an excellent feedback.

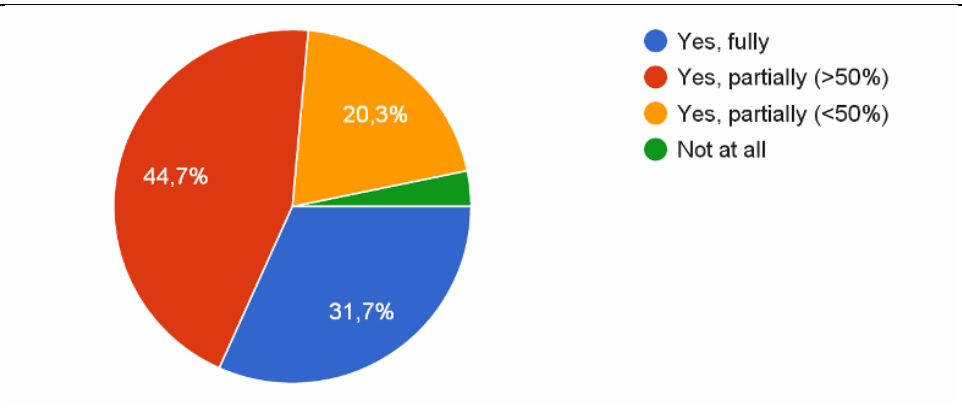


Figure 32: Achievement of the expected objectives in terms of efficiency?

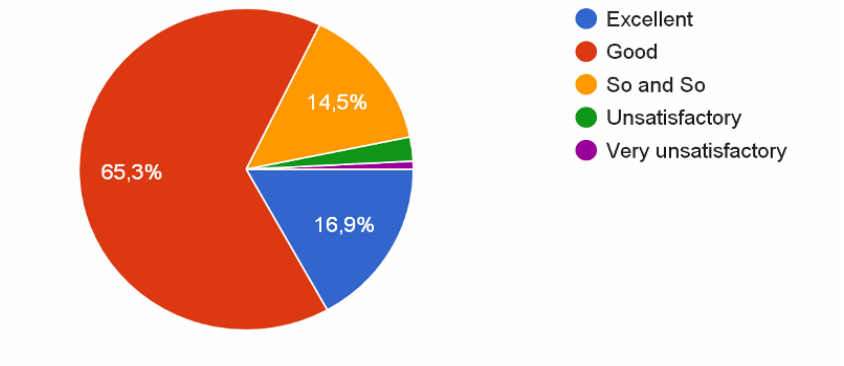
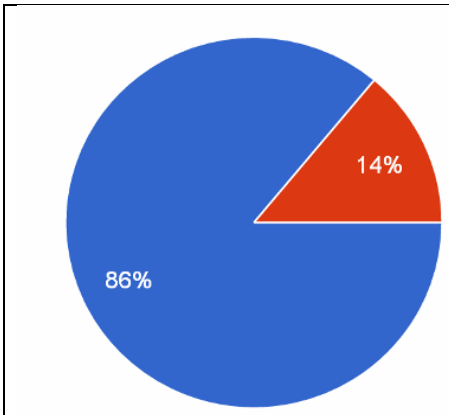


Figure 33: Feedback on the efficiency path taken by the companies

2.8 Economic feasibility of energy efficiency investments

This section summarises the final part of the survey, which examines the economical and managerial factors of energy efficiency measures. Despite achieving a reduction in energy bills, industry continues to see the economic feasibility of the investments as a determinant factor for the implementation of energy efficiency measures

The vast majority of participants considered high energy-costs as an important driver to implementing energy efficiency measures, but the vast majority of participants also stated high investment costs as a barrier to implementation. However, 50% of the participants only considered investments costs to be of medium level importance and even less participants stated investment costs as a high-level barrier for implementing energy efficiency measures.



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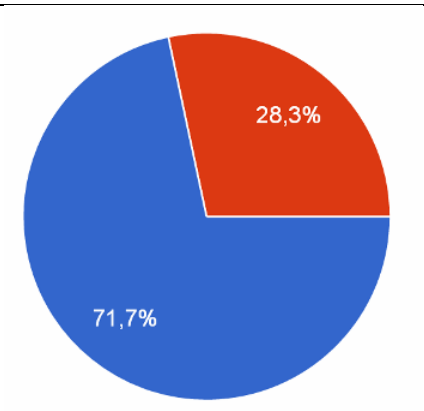


(b)

Figure 34 (a): Consideration of energy costs as a decisive factor for implementing energy efficiency. (Bleu: YES, red: NO)

34 (b): Consideration of the investment costs (CAPEX) of energy efficiency investments as a barrier to their implementation (bleu: YES, red: NO)

Despite declaring investment costs as a "barrier" to the implementation of energy efficiency measures, most of companies had, in the past, financed energy efficiency measures using their own capital, signalling that they are willing, at least in principle, to bear the costs. Others companies, as shown in Figure 35, have applied for loans, and a small number of companies have taken advantage of European Union projects or structural funds.

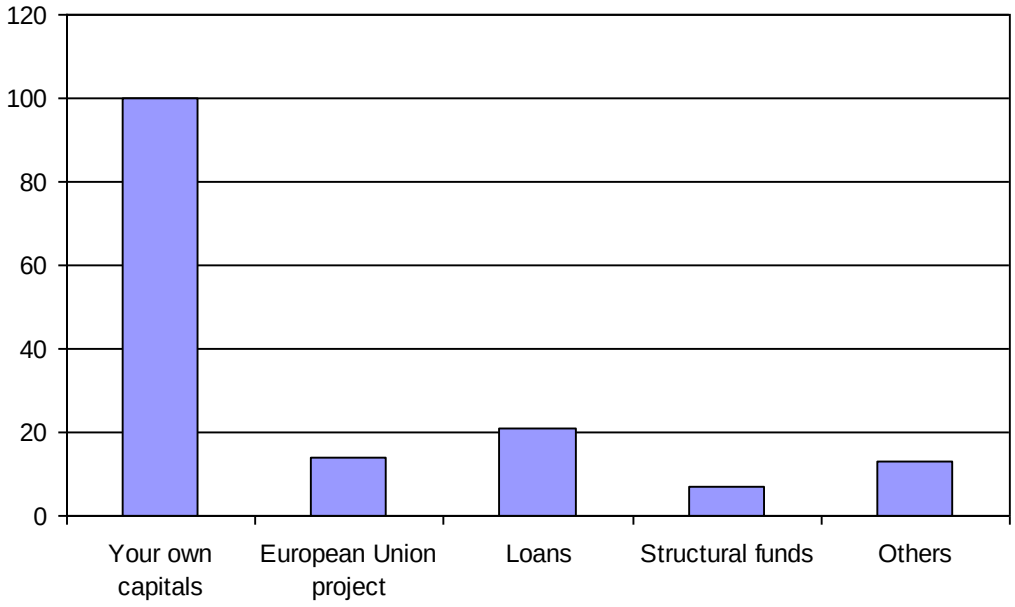


Figure 35: Ways of financing energy efficiency measures in the past

The results look similar when asking about future funding of energy efficiency measures. Again, the vast majority of companies declare that they are planning to finance future energy efficiency measures from their own capital. However, 17.1% of companies are willing to apply for EU funding in the future (see Figure 36).

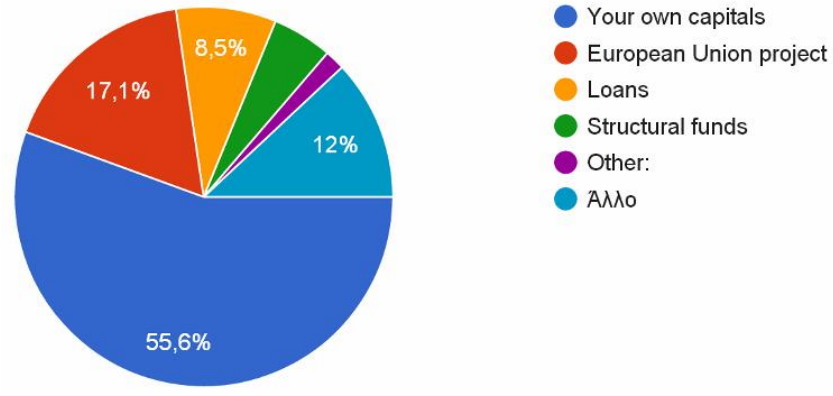
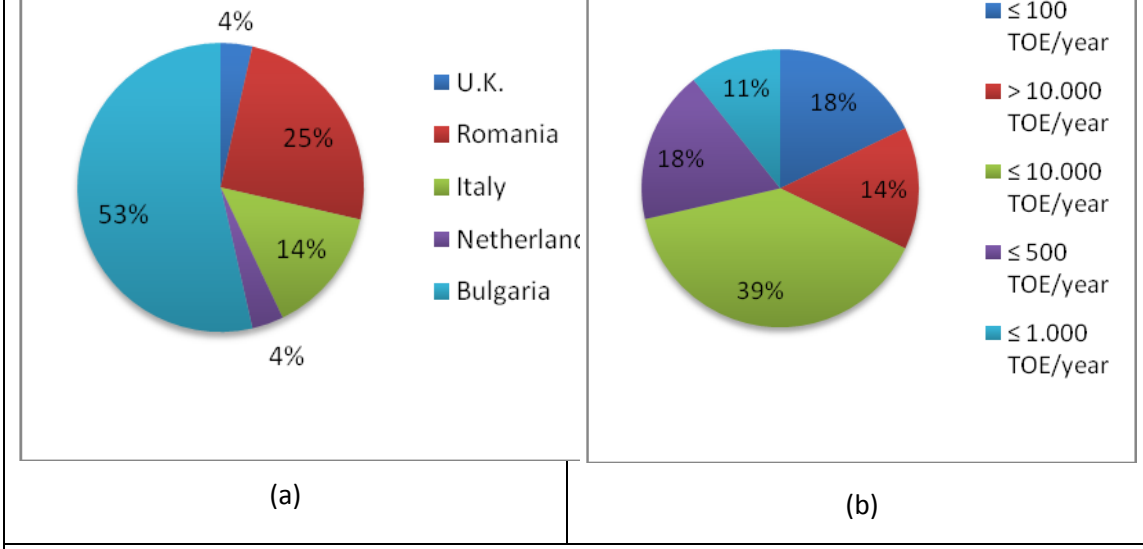


Figure 36: Ways of financing energy efficiency measures in the future

At this point, a further analysis has been done in order to examine the factor of company size and origin in relation to the financing the energy efficiency measures in the future. More specifically, the application to EU in order to join a project is studied, in relation to the country and the size. As it can be seen, most of the interested industries are coming from Bulgaria and Romania. Furthermore, the industries of <10.000 TOE/ year are more willing to apply for joining a EU project.



(a) (b)

Figure 37: Analysis of the industries willing to financing energy efficiency measures in the future by applying to EU project (a): By country of origin

37(b):By size

The next question examined the type of financial instrument that had been chosen in order to support the investment of energy efficiency measures. Figure 38a shows that most of companies have previously preferred to use subsidies, followed by tax incentives and then other types of support to finance energy efficiency measures. The smallest percentage of respondents have benefited from a feed-in-tariff for the heat or electricity produced. The choice of future financial instruments differs from financial instruments previously used. In the future, the majority of companies declare that they are willing to make use of subsidies, then tax incentives and only 8.9% will take advantage of feed-in-tariffs.

(a) (b)

Figure 38: Types of financial instrument used in the past (a) and in the future (b) to support energy efficiency investment

Some further country analysis was proven helpful, in order to examine the national finance opportunities of the industry in the EU. The Italian industries seem to prefer tax incentives, the Dutch, Romanian, Bulgarian, Czech and Polish subsides, the UK a combination of subsidies and tax incentives, while the industries from Slovenia and Greece are preferring other ways of schemes.

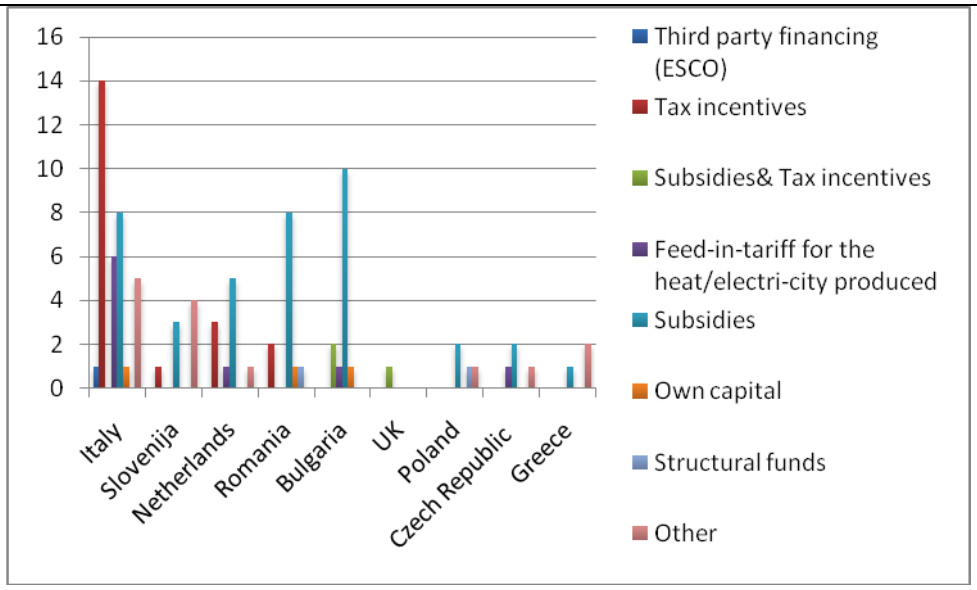
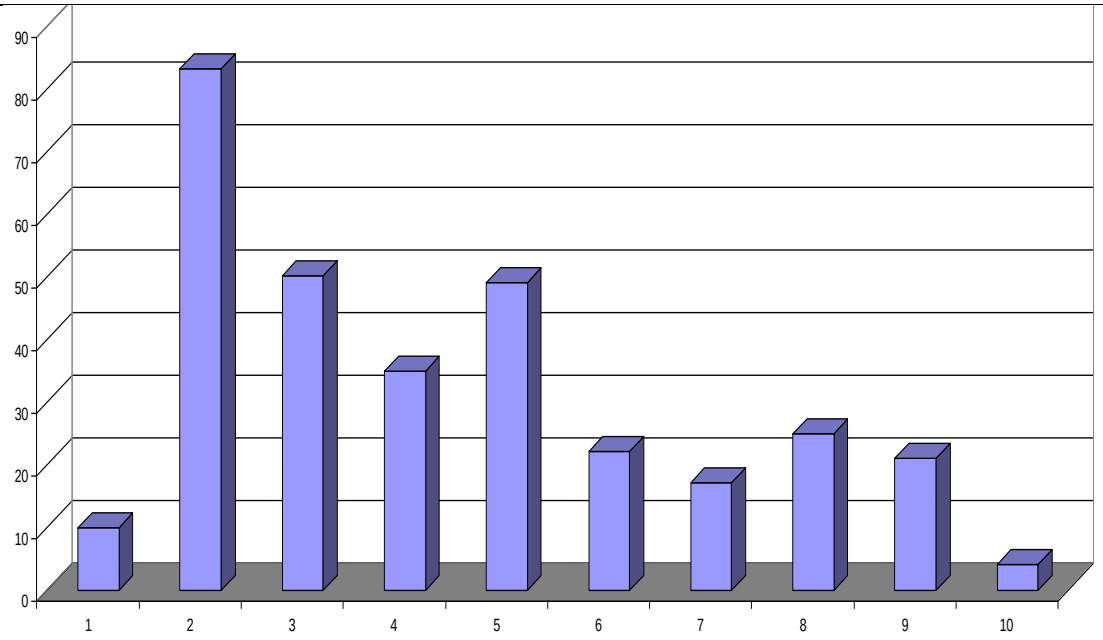


Figure 39: Types of financial instrument preferred to be used in the EU countries the future

The percentage of companies which had made use of other types of support in the past seems to remain more or less the same for future use. From these results, the assumption can be made that companies are overall satisfied with the use of subsidies, tax incentives and of other types of support as financial instruments, and less satisfied with the use of feed-in- tariff as a financial instrument to finance energy efficiency measures.

2.9 Economic and procedural barriers of energy efficiency investments

In order to gain a better perspective on the barriers to implementing energy efficiency investments, a more in depth analysis into this issue is required. Most participants indicated that the most important barrier to investing in energy efficiency was a long payback period, followed by the accessibility of subsidies as well as a high level of bureaucracy. Other barriers are shown in Figure 40.



1: No obstacles
2: Too long payback period
3: Barriers to access subsidies
4: Barriers to access financing
5: Mistrust of bureaucracy
6: Little awareness of the top management
7: Internal organization hampers
8: Doubts on impact on the production
9: Unreliability of mid-term market
10: Other

Figure 40: Obstacles hamper or reduce the investments in energy efficiency (multiple choice)

On the other hand, the most important factor for investing in energy efficiency measures is the presence of an investment subsidy (valorized of high importance) followed by fuel price stability. The least important factor for investing in energy efficiency was the familiarity of banks with energy efficiency projects. This can be linked to the fact that most companies used their own capital to finance EE projects.

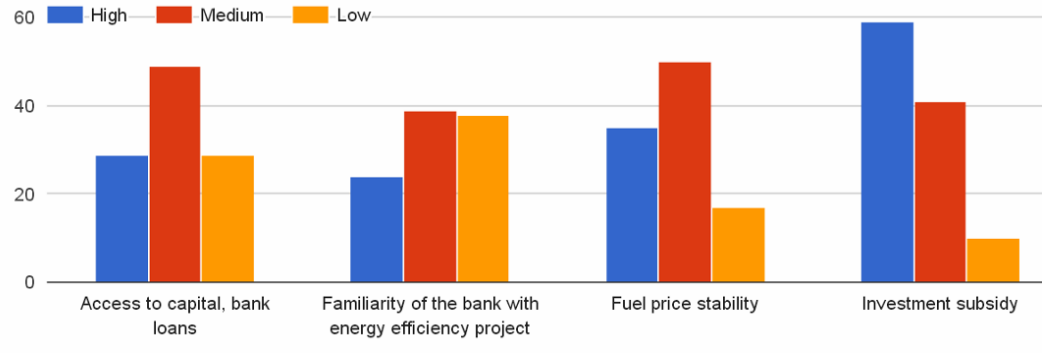


Figure 41: Valorization of importance of factors for investing in Energy Efficiency Measures

The next question focused on the barrier to implementing energy efficiency measures. The results in Figure 42 show that the largest barrier is the procedures, time and costs needed to submit and acquire a grant. The *procedures, time and cost needed for researching the best fitted technology* is declared to be almost as important as the ones needed for the submission of the application for adopting this technology. The *procedures, time and cost needed for the provision of data for monitoring the consumption of the implemented policy/ measure* have been indicated as the least important barrier to the implementation of energy efficiency measures.

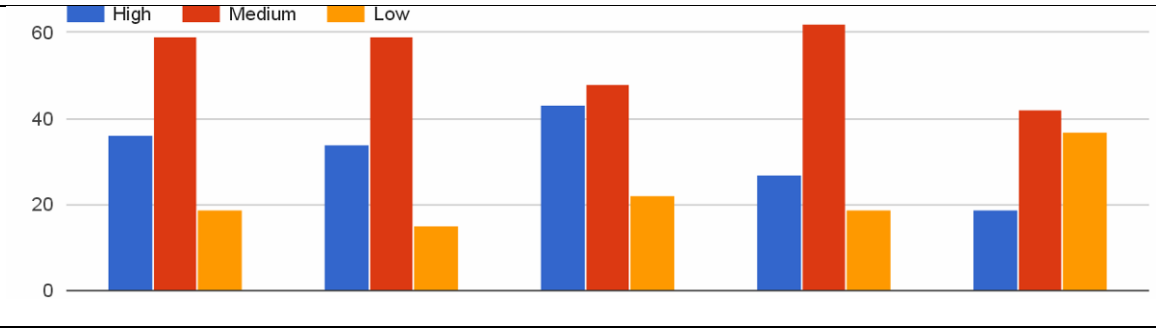
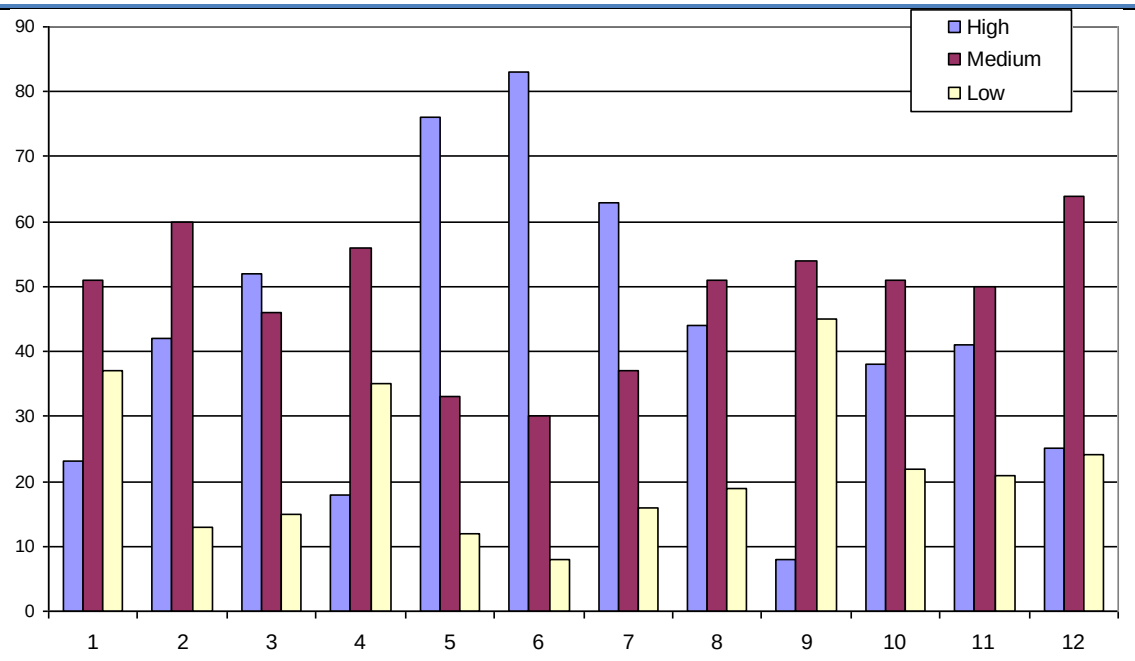


Figure 42: Valorization of importance of factors as barriers for implementing in Energy Efficiency measures
1: Procedures, time and cost for researching which technology fits best, for the EE measure
2: Procedures, time and cost for submitting an application for adopting this technology making
3: Procedures, time and cost to get the grand
4: Procedures, time and cost to implement the measure
5: Procedures, time and cost for providing data for monitoring the consumption of this policy

2.10 Organisational feasibility for implementing energy efficiency measures

Finally, the survey focused on the internal barriers and drivers of energy efficiency measures within a company. The alternatives targeted to the identification of the factors are believed to lead to a successful development and implementation of the energy efficiency measures. These factors have been either internal, examining the company's knowledge or availability concerning the implementation of energy efficiency measures, or external, concerning socio-political factors like regulatory frameworks or social acceptance. The results are presented in the Figure 43.



1: Employment creation
2: Availability of Information/ advice
3: Availability of service of experts
4: Availability of ESCOs
5: Knowledge of your company's energy consumption
6: Knowledge of the available solutions
7: Availability / Ability of your engineers
8: Improvement of your products/services due to the investment
9: Social acceptance
10: Regulatory frameworks
11: Stability of frame conditions (RES-targets, incentives...)
12: Contracting solutions availability

Figure 43: Importance of factors for the positive development of the Energy Efficiency Measures

The three factors that the responding companies have declared to be most important for a positive development of energy efficiency measures are the knowledge of the available solutions, the knowledge of the company's energy consumptionand the availability/ability of the company's engineers- hence, all these factors are concerning internal information and management. This leads to the conclusion that for the positive development of energy efficiency measures, refined planning and research is essential in order to identify the appropriate measure recommendation for each company and its specific energy consumption profile. In order to achieve this, devoted engineers with the necessary knowledge and experience are essential.

3 Market Analysis- ESCOs

3.1 Energy Service Company

In order to achieve a more complete picture of the current status of energy efficiency in industry, European ESCOs were invited to complete an almost identical questionnaire. Most of the participated ESCOs have stated that they are not affiliated to a group.

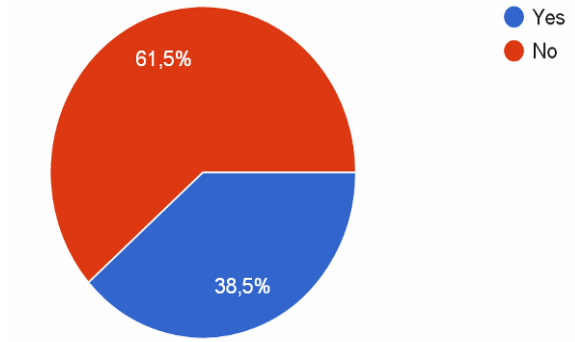


Figure 44: Companies affiliated to a group

As a next step, it was essential to identify the prevalent energy efficiency service (in %) provided by each ESCO. Most ESCOs stated that they provide consultancy and recommendation design, followed by a smaller group of ESCOs, which stated that they provide "monitoring and accounting" services. At this point it should be highlighted that ESCOs provide advice and/or measurements rather than investments, as demonstrated by the fact that only 5% of ESCOs chose "financing" as their answer, and even fewer provide support in helping to start-up and operate companies.

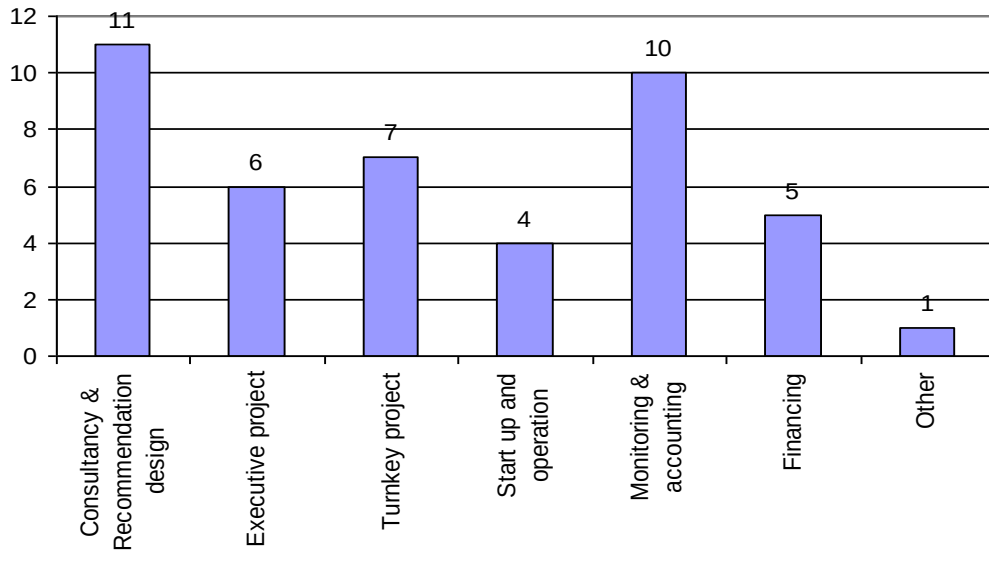


Figure 45: Prevalent Energy Efficiency service (%) provided by the ESCO

In order to get additional information on the provided service, the survey asked the ESCOs to identify the average number of companies that benefit from their services. Most of the ESCOs have declared that 5 companies per year on average ask for their support. Furthermore, the majority of the companies served by the ESCOs are large companies (more than 250 employees), followed by medium size companies (50-250 employees) and the smallest percentage of companies served by ESCOs is small (less than 50 employees). Since most ESCOs that responded to the survey serve large sized companies, the results/conclusions mainly apply to large sized companies and cannot necessarily be applied to SMEs.

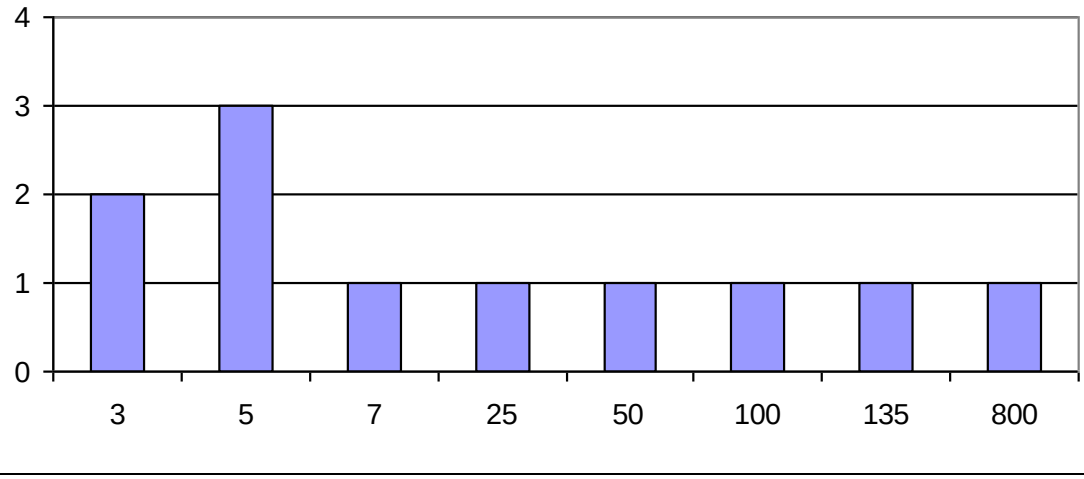


Figure 46: The average number of Companies that benefit of the ESCO services per year

3.2 Energy use

This section aims to identify the way energy is consumed in the companies served by the ESCOs which have responded to the survey. Firstly, the questionnaire asked for the average yearly energy consumption and the incidence of thermal and electrical uses. Figure 47 shows that the companies served by ESCOs cover all energy consumption ranges. The vast majority of companies, served by the ESCOs, consume between 10-500 TOE/year and between 100-10.000 TOE/year, followed by 28.6% of companies that have the smallest energy consumption of less than 100 TOE/year.

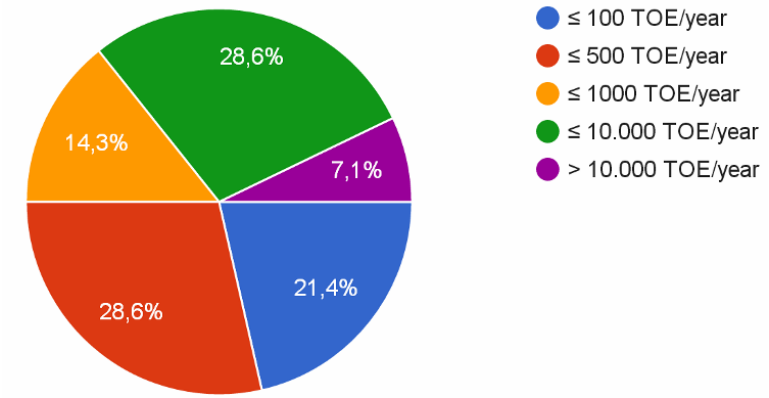


Figure 47:Average yearly energy consumption level of the served companies (100TOE= 1,16 GWh)

The average percentage of thermal energy use compared to electricity use for most companies was between 0% and 25%, followed by companies consuming between 25-50% thermal energy as a percentage of electricity. Only 7.1% have indicated the incidence to be between 50-75% and none have indicated the ratio of thermal to electricity usage to be between 75-100%.

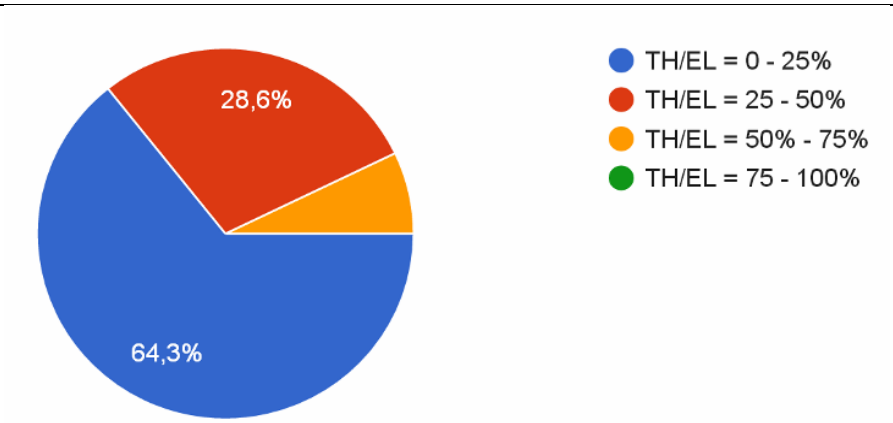


Figure 48:The average energy incidence of the thermal uses with respect to the electricity uses in the served companies processes

Most companies served by ESCOs do not have a system for self-production of energy for electricity production. As shown in Figure 49, most participating ESCOs have reported that only between 0% and 10% of their companies have such systems. The rest of the ESCOs have reported that in equal shares the 20%, 25%, 30%, 40%, 50% and 60% of the companies they serve, produce their own electricity.

Concerning the production of heat, most ESCOs state that 90% of the companies they serve are equipped with an energy self-production system. The results with respect to cogeneration systems can be seen in Figure 49c.The questions related to Figures 49a, b and c, allowed ESCOs to enter the exact percentage of companies equipped with an energy self-production system rather than select a range.

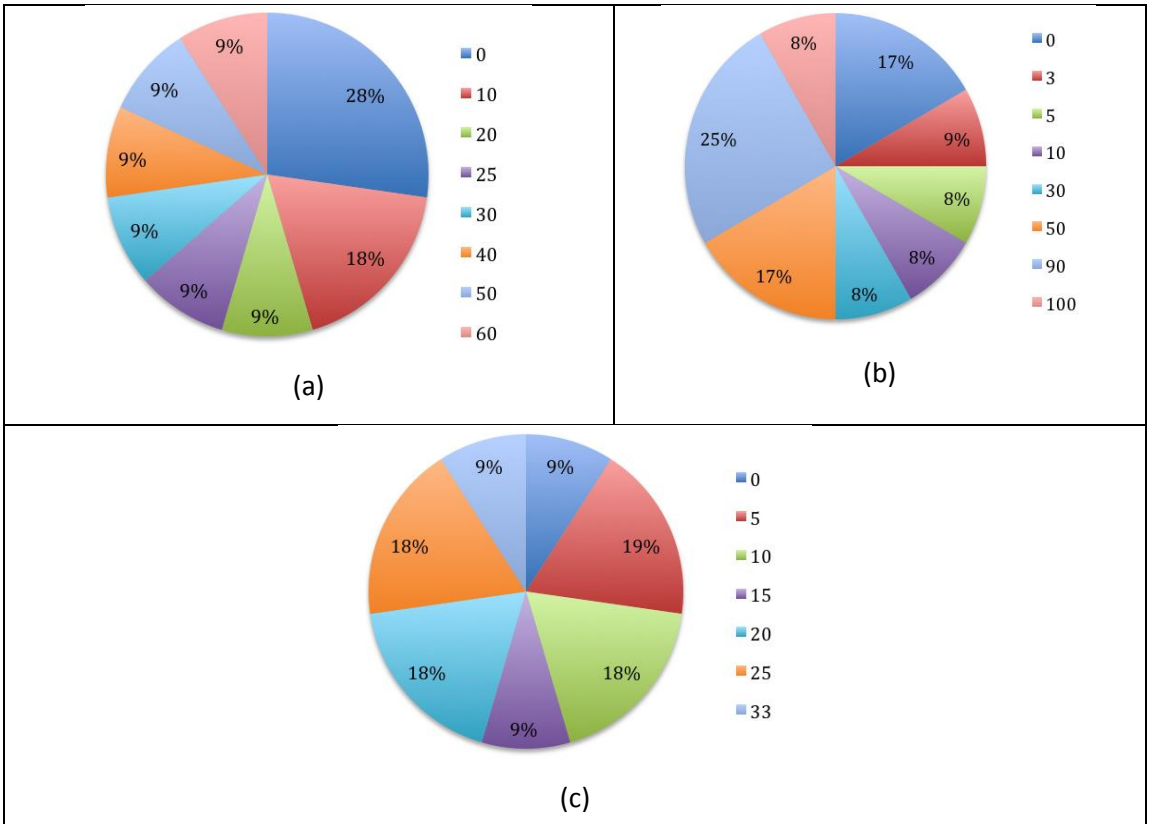


Figure 49:
(a) The percentage of companies equipped with a system for self-production of energy for electricity production (%)
(b) The percentage of companies equipped with a system for self-production of energy for thermal production? %
(c)The percentage of companies equipped with a system for self-production of energy for cogeneration (%)

3.3 Energy Efficiency approach

This section examines the approach of companies served by ESCOs towards energy efficiency. According to the survey, the vast majority (77.8%) of ESCOs' served companies do participate in Energy Efficiency support Obligation schemes (such as the white certificates scheme), while the other 22.2% of companies participate in other Energy Efficiency support schemes. 56% of companies served by ESCOs participated in the schemes as voluntary parties, while 44% were obligatory parties.

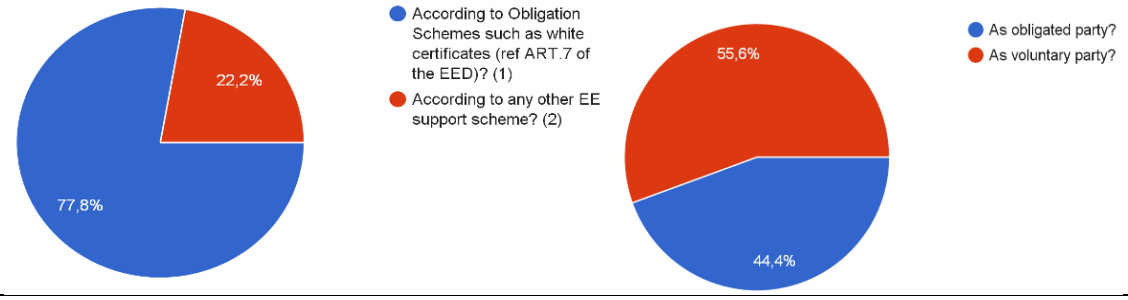


Figure 50: Participation to any Energy Efficiency support scheme (such as energy efficiency obligations, grants, feed-in tariffs, tax credit/deductions, guarantee funds, etc.), and if YES, as obligatory or voluntary party

The percentage of energy-audited companies which implemented energy efficiency measures, is shown in Figure 51. The majority of ESCOs responded that either 10%, 20% or 100% of the companies they serve that have undergone an energy audit, have implemented the identified energy efficiency measures.

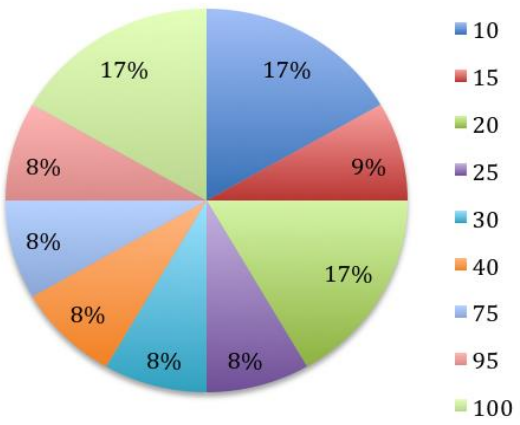


Figure 51:The percentage of energy audited companies which really implemented EE corresponding measures

The survey continued with registering the percentage of companies with energy managers, as well as the percentage of companies that have been certified by an ISO standard. Figure 52 shows that an equally share of the ESCOs have stated that 25% or 30% of their served companies have energy managers in place.

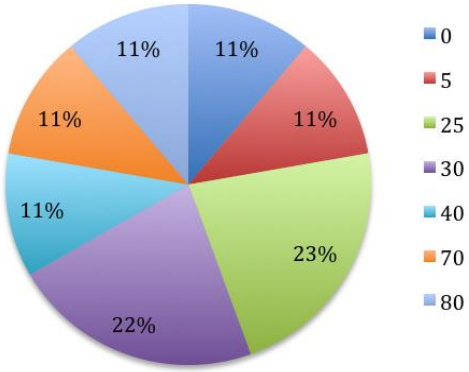


Figure 52:The percentage (%) of companies with an appointed energy manager

With respect to ISO50001, the majority of ESCOs (40%) stated that none of the companies they serve have been certified. This leads to the conclusion that ESCOs undertake part of the work for industries that 'avoid' or have no interest in certifying to ISO standards.

The next significant percentage of ESCOs (20%) indicated that 5% of the companies they serve have ISO certifications, which is still a low percentage and verifies the previous conclusion.

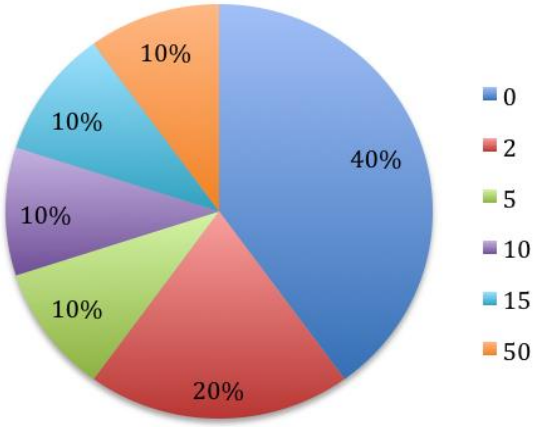


Figure 53:The the percentage % of companies certified to ISO 50001

3.4 Motivations towards Energy Efficiency measures

The ESCOs declared that most of their costumers/industries had decided to invest in energy efficiency measures in order to reduce their energy costs, followed by those who decided to invest in energy efficiency measures due to country-specific legal obligations.

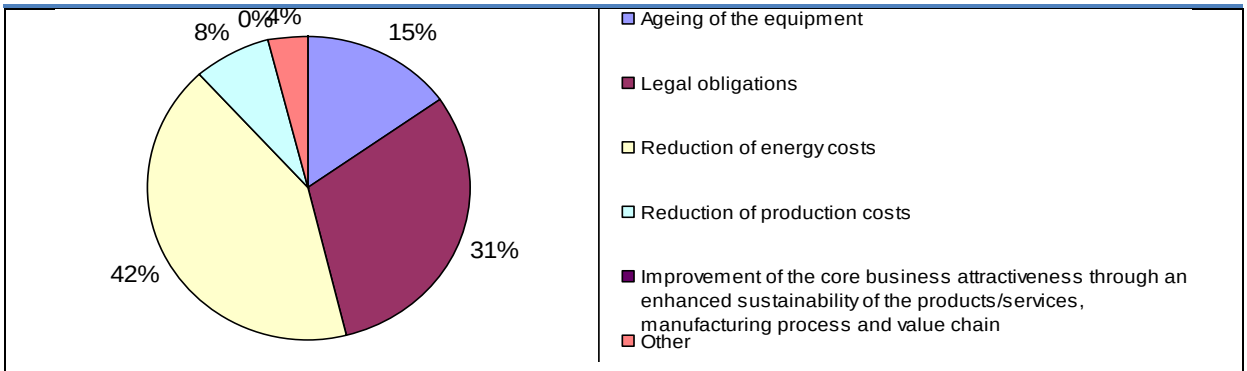


Figure 54: Main motivation of the companies served by ESCOs for investing in energy efficiency

3.5 Technical description of EE measures

Most of the companies served by the ESCOs have applied energy efficiency measures to manufacturing processes, followed by interventions to services and infrastructures (e.g. internal transport, lighting, heating, etc.). The third most common intervention was an improvement in the management and organization of production and work (e.g. ISO 50001, LEAN manufacturing, behavioural change, etc.). The lowest percentage of interventions was related to the application of measures to the company buildings.

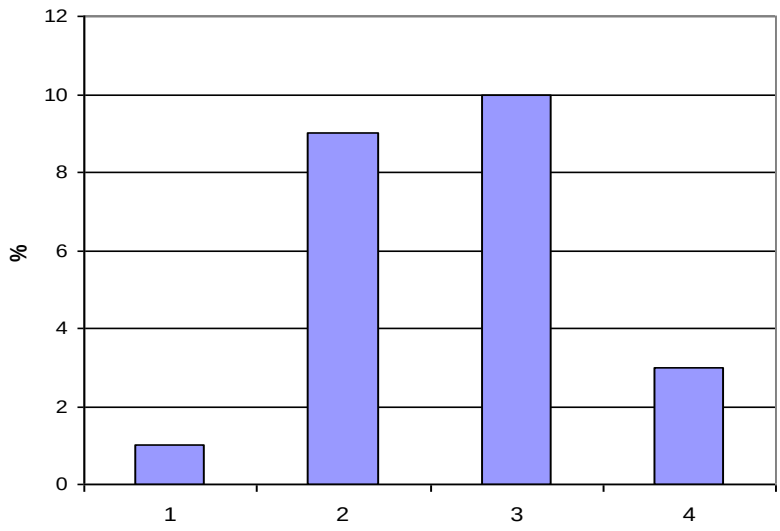
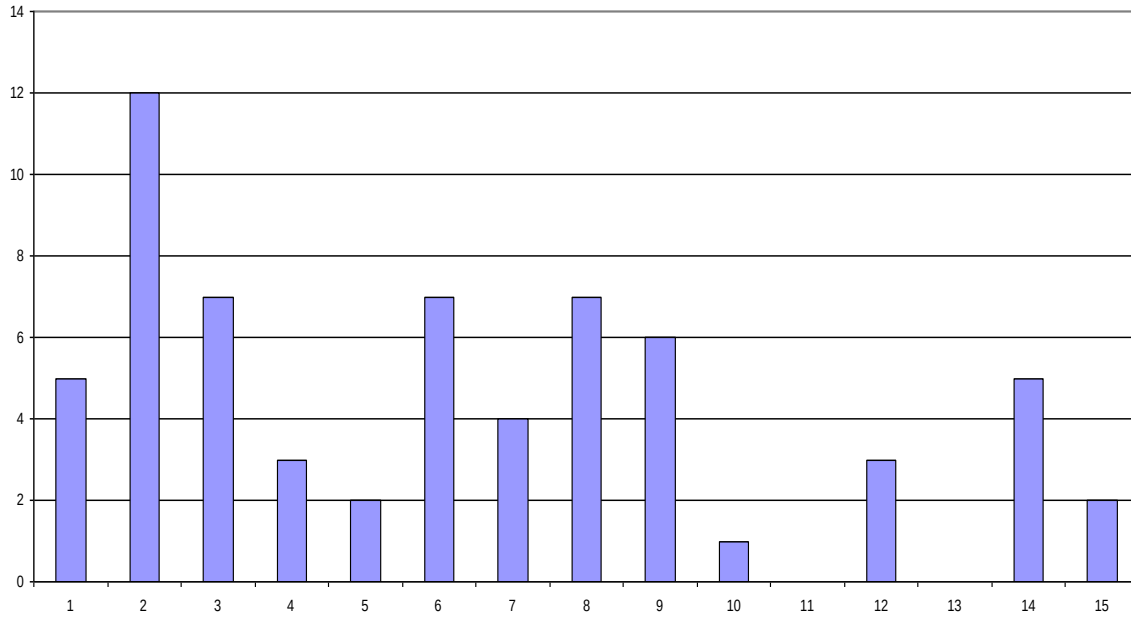


Figure 55: Mainly addressed energy efficiency measures are to reduce energy consumption
1:Company buildings
2: Services & infrastructures (e.g. internal transport, lighting, heating, etc.)
3:Manufacturing processes
4: Improvement of management and organization of production and work (ISO 50001, LEAN manufacturing, behavioural change, etc.)

Most of the companies served by ESCOs chose to implement inverters (VSD systems), followed by the installation of renewables, the implementation of an intervention on the compressed air system

and the power factor correction of electrical loads. The results of this question can be seen in Figure 56.



1: Use of high efficiency electric motors
2: Use of inverters (VSD systems)
3: Power factor correction of electrical loads
4: Efficient combustion systems
5: EE improvement of UPS
6: Intervention on the compressed air system
7: EE improvement of cooling systems
8: Self-production from renewable energy sources
9: Cogeneration plant
10: Trigeneration plant
11: Heat recovery and power generation ORC
12: Flue gas heat recovery, drains, heat waste
13: Sustainable production process equipment
14: Energy management systems (PLC, automation ...
15: Other

Figure 56: Solutions (% of the overall services) that have been adopted in the companies served by ESCOs in the field of energy efficiency, concerning the manufacturing processes

3.6 Level of satisfaction from the implementation of EE measures

This section examines the overall satisfaction with the implemented measures. As in Chapter 2, which focuses on the questionnaire's results from individual companies/industries, most of the companies served by ESCOs have noticed a reduction of 5-10% in their annual energy bill after the implementation of energy efficiency measures, followed by 21.4% of companies saving more than 20% and an equal share of companies saving less than 5%.

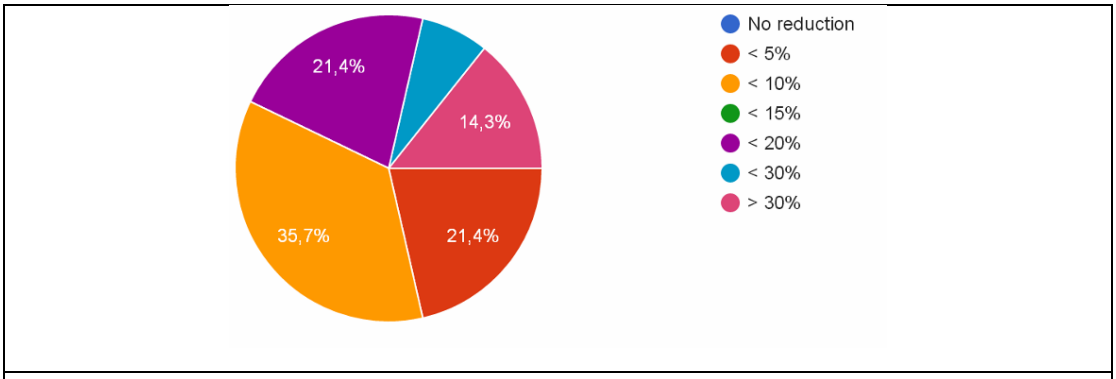


Figure 57: Average reduction in the annual energy bill following the implementation of energy efficiency measures

As a consequence, most companies (57.1%) have classified their satisfaction with the results of the implemented EE measures as good, followed by 35.7% of companies, which only perceived the results as "so and so", and only 7.1% of companies characterized the results achieved from the implementation of energy efficiency measures as "excellent".

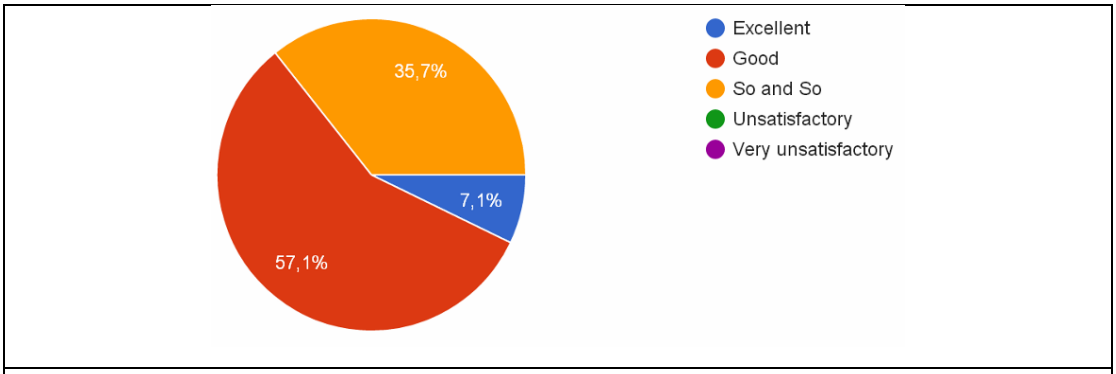


Figure 58: Feedback on the efficiency path taken by your association?

3.7 Economic feasibility of energy efficiency investments

Most companies served by ESCOs consider the investment cost of the energy efficiency measure to be the decisive factor when making the decision to invest. Still, the opinions on whether the cost of the maintenance and operation of the energy efficiency investment are considered to be a barrier are divided, as seen in Figure 60a. 50% of companies that considered the maintenance and operational costs to be a barrier, only considered it to be of medium importance, 33% considered it to be of high importance and 17% only considered it to be of low importance. Hence, for the majority of companies that see operation and maintenance costs as a barrier, considers this to be quite an important barrier.

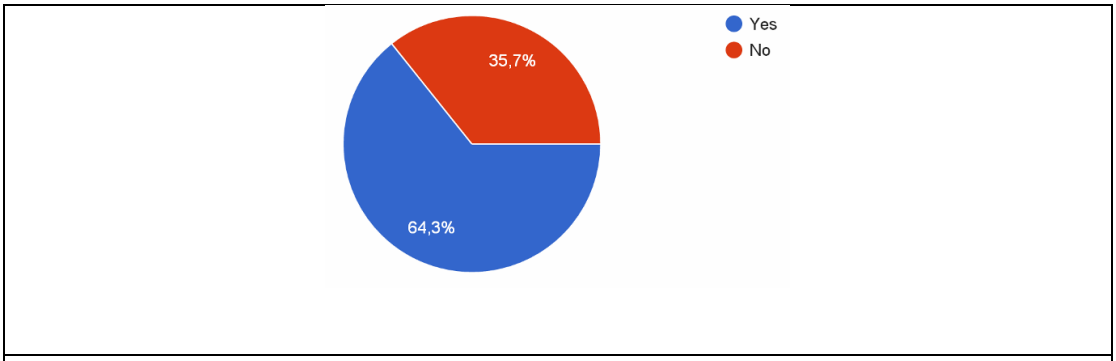


Figure 59: Energy investment cost as the decisive factor for implementing energy efficiency measures in the served companies

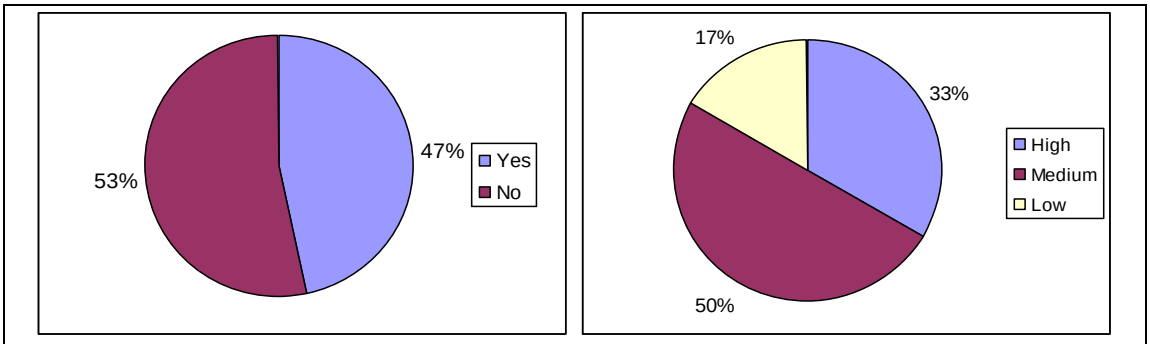


Figure 60: (a) Are operational & maintenance cost of energy efficiency investments considered a barrier in your company?
(b) If Yes, at which level?

One of the reason that explains why the cost of investments is a barrier to the implementation of energy efficiency measures, is that most companies served by ESCOs (55%) have used their own capitals to finance these measures. Only 25% of companies have used loans, and an even smaller percentage (15%) has used structural funds, whilst none had ever applied for a EU project. 5% have chosen other ways of financing.

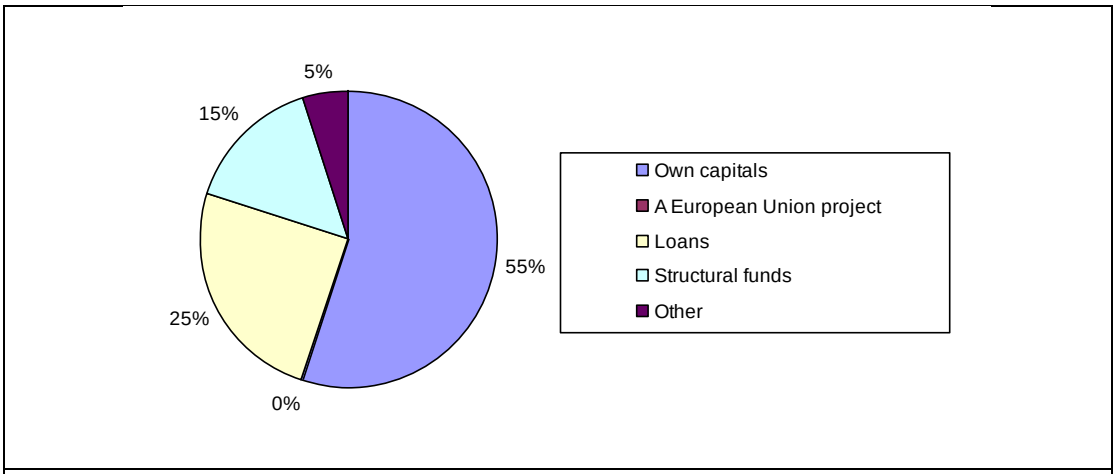


Figure 61: Ways of financing the energy efficiency measures

Furthermore, the most common financial instruments used to fund energy efficiency measures were subsidies and tax incentives, chosen by 34% and 33% of the companies, respectively. The next most popular financial instrument is the feed-in-tariff for the heat/electricity produced.

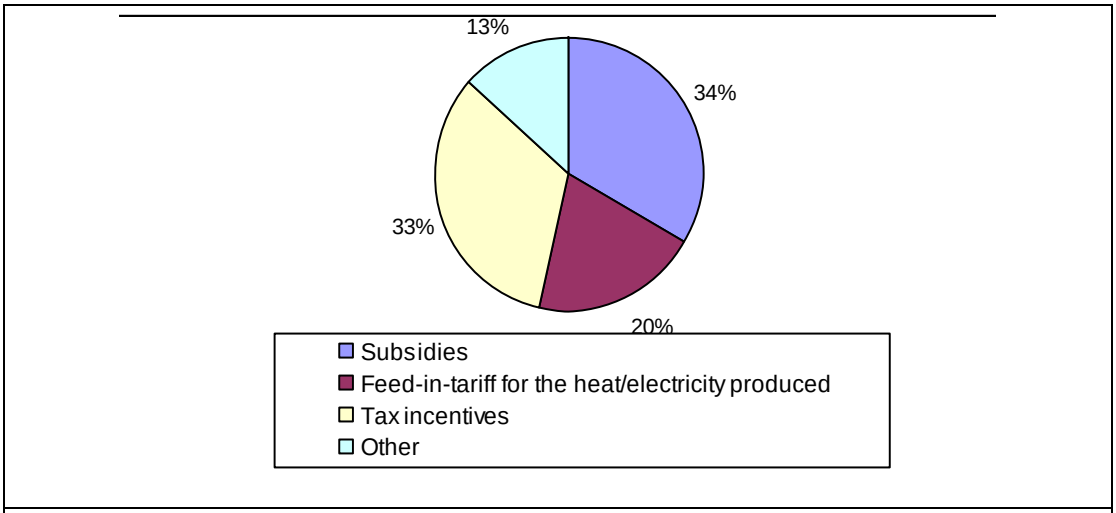


Figure 62: Financial instruments usually used

3.8 Economic and procedural barriers of energy efficiency measures

In order to obtain a more complete picture of the barriers to implementing energy efficiency measures, the survey asked the ESCOs what, in their opinion, prevented the companies they serve from investing in energy efficiency measures. Bureaucracy and a long payback period were declared to be the most important barriers (see Figure 63), followed by the access to financing (13%), access to subsidies (13%) and the awareness of top management (13%).

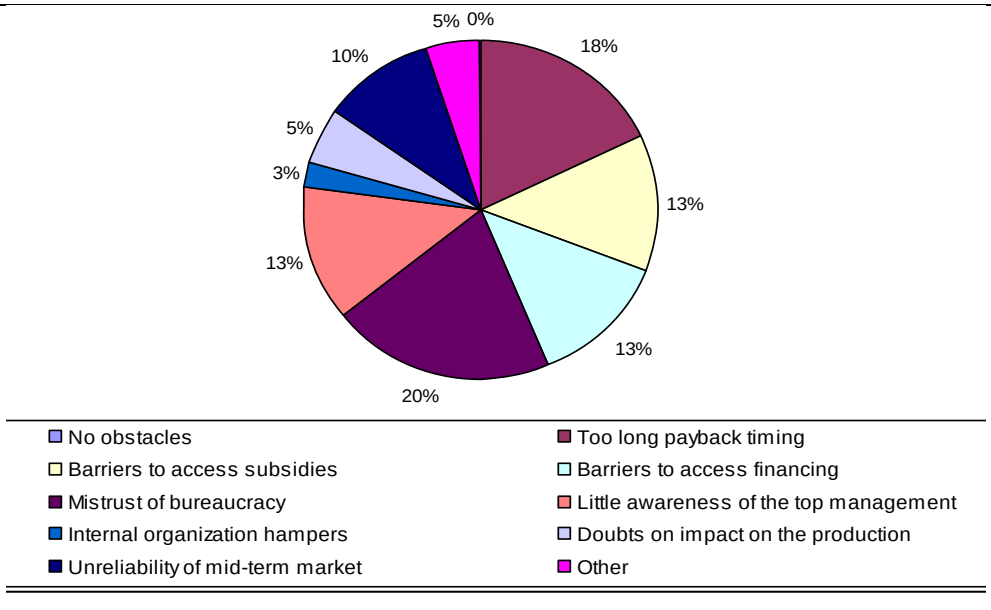


Figure 63: Obstacles that hamper or reduce the investments in energy efficiency

Next, the ESCOs were asked which initiatives could encourage the companies that they serve to invest in energy efficiency measures. The results are presented in Figure 64, which shows that providing investment subsidies is considered to be the most important factor to encourage investment in energy efficiency, while fuel price stability is considered to be the least important factor.

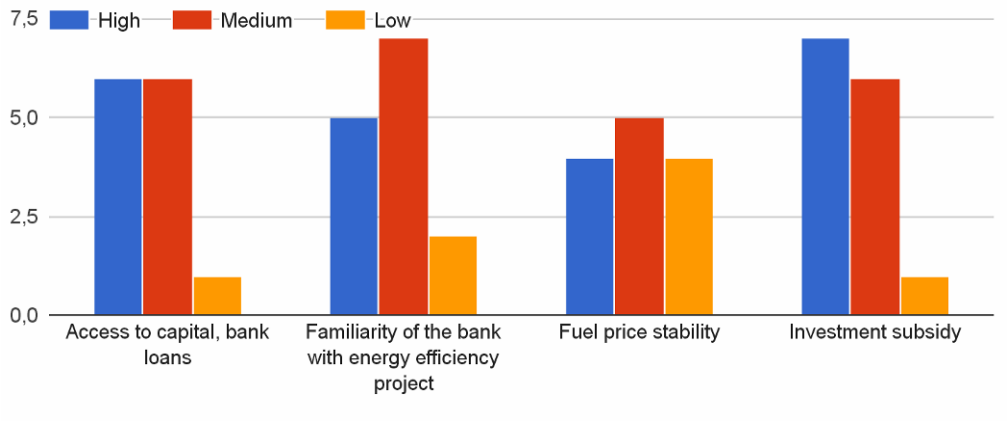


Figure 64: Obstacles that hamper or reduce the investments in energy efficiency

The most important barrier to the implementation of energy efficiency measures is considered to be the *procedures, time and costs required to provide data for monitoring the effectiveness of the measure* as well as the *procedures, time and costs required to implement the measure*. The *procedures, time and costs required to receive the grand* is perceived to be of less importance in comparison with the other factors; however, it has been still valued as of high and medium importance. The factor " *Procedures, time and cost for researching which technology fits best, for the E.E. measure*" has received the highest "low importance" valorization in relation to the other factors. The detailed results of different factors acting as barriers to the implementation of energy efficiency measures can be seen in Figure 65.

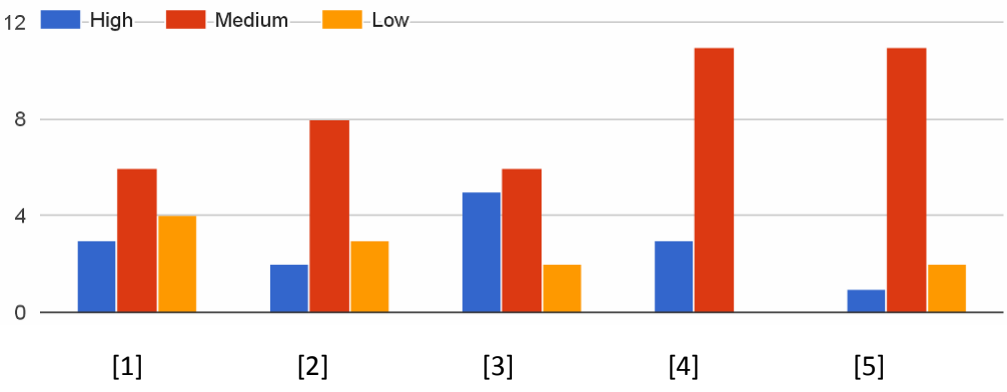


Figure 65: Importance of factors considered as barriers for implementing energy efficiency measures
[1]: Procedures, time and cost for researching which technology fits best, for the E.E. measure

[2]: Procedures, time and cost for submitting an application for adopting this technology making use of the specific policy
[3]: Procedures, time and cost to get the grand
[4]: Procedures, time and cost to implement the measure
[5]: Procedures, time and cost for providing data for monitoring the effectiveness of the measure

4 Market Analysis- Associations

4.1 Profile of Industry Associations

Thirteen industry associations from different EU countries (Bulgaria, Czech Republic, The Netherlands, Romania, Portugal, Slovenia, Sweden and Italy) have participated in the survey. The industry associations that took part in the survey cover a variety of sectors, such as biogas, energy consumers, industries of food and drinks, oils and fats, wood and furniture, cement and construction minerals etc. Figure 66 shows the size of the associations, by number of member companies, which have participated in the survey. The majority of associations have 10-50 members.

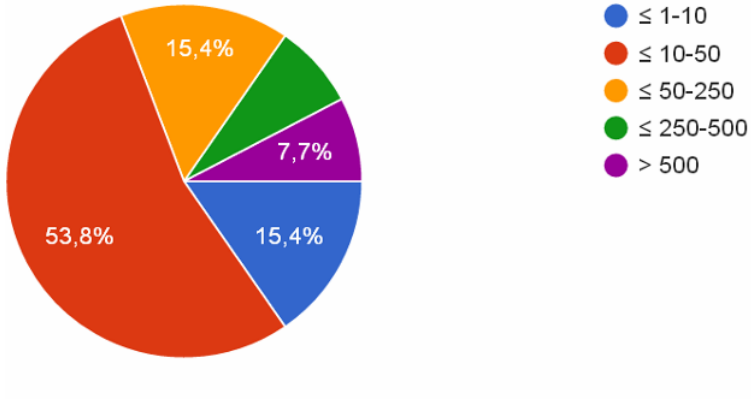


Figure 66: Association size – number of represented companies

4.2 Awareness of Energy issues

The vast majority of the industry associations that participated in the survey support their member companies with matters related to energy efficiency, and consider this to be of high importance, while only 8.3% of trade associations see energy efficiency of medium importance. The associations also had the option to list some of the supporting activities they have provided to their companies. Some of the answers include: provision of a full support program on energy efficiency for their members and innovation in their supporting services; provision of support to the companies to cope with the energy efficiency covenant; support to create lists with energy efficient measures for the smaller companies that are not part of the covenants.

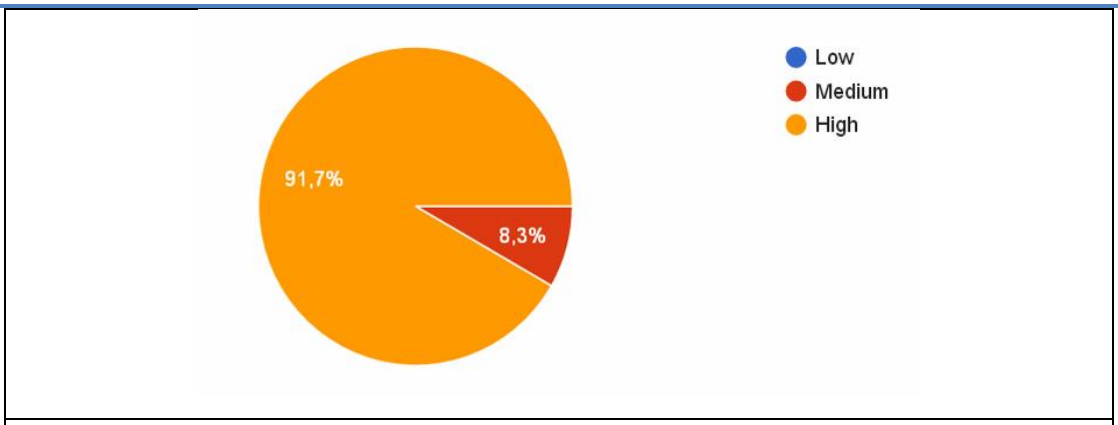


Figure 67: Importance of energy efficiency in the support of the Association towards the member companies

The results of the survey show that most of the associations represent companies that in general have a high level of awareness with respect to energy issues, while some of the companies are characterized to have medium awareness. The survey then examined the energy costs as a percentage of total costs in order to assess the need for the implementation of energy efficiency measures. This question allowed for "open answers". The majority of the companies have energy costs that make up between 2% and 10% of their total costs, followed by those who have high energy costs (more than 10% of their total costs) and only 18.2% have energy costs less than 2% of their total costs. This leads to the conclusion that for the vast majority of companies, energy is an important cost, since 64% of participants claim they their energy costs are 2% or more of their total costs.

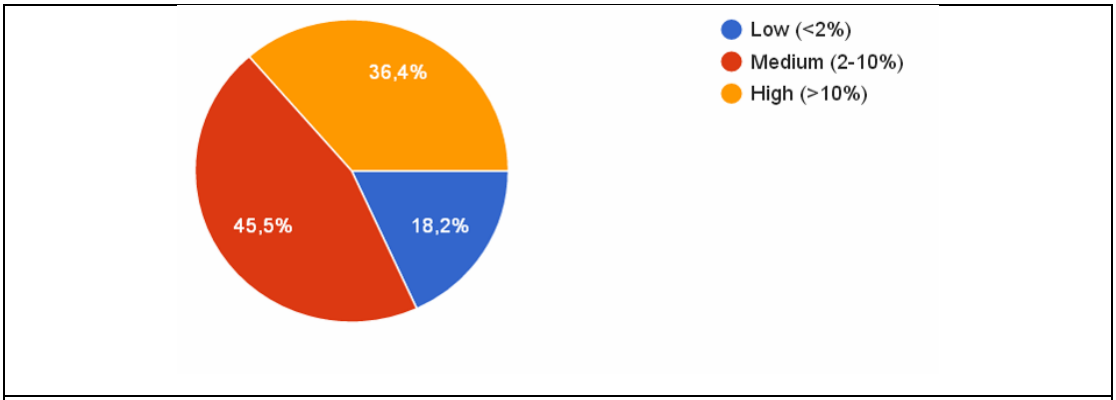


Figure 68: What's the incidence of the energy costs in the activities of represented companies

However, despite the fact that energy costs are characterized as medium or high by the majority of the participants, the associations stated that most companies are cautious with respect to the effectiveness of energy efficiency measures, as most of them believe that companies have medium to strict margins to reduce their energy costs through efficiency improvements. This contradicts with the idea of companies served ESCOs and this is very important message. Very few see the possibility of a wide reduction.

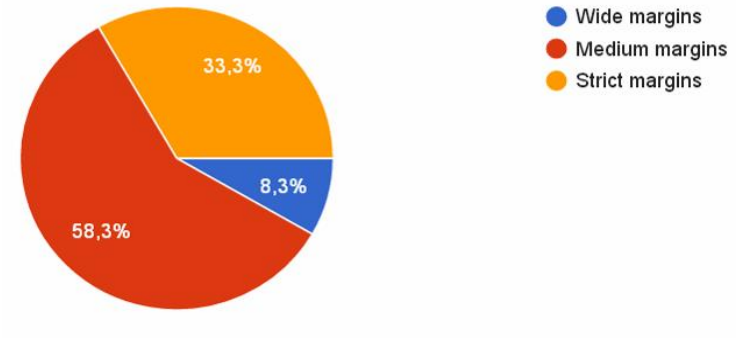


Figure 69: Do you think that represented companies have margins to reduce their energy costs through efficiency improvements

4.3 Energy use

This section continues by asking in more depth about the energy use of the member companies of industry associations that participated in the survey. Figure 70 shows the percentage of the companies' yearly average energy consumption level. It can be noticed that most of the companies that are members of the associations that have taken part in this survey, consume a large amount of energy: the majority of the companies consume more than 10.000 TOE/year, while 33% consume in the range of 1.000-10.000 TOE/year.

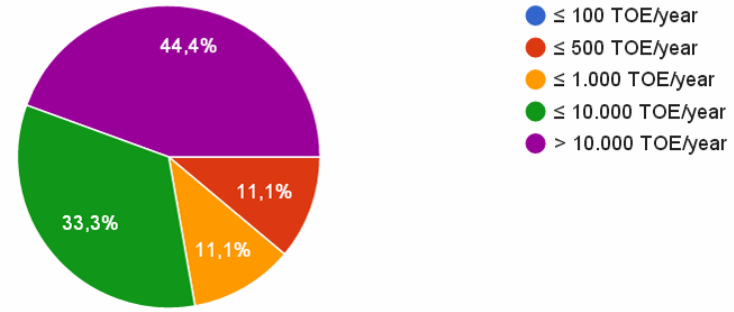


Figure 70: What's the yearly average energy consumption level of the associated companies

Figures 71 and 72 summarise the electrical and thermal energy consumption of the companies that are members of the industry associations that have taken part in this survey. In Figure 71 is shown that the majority of the companies (55.6%) consume more than 10.000 TOE/year, while 22.2% of companies consume in the range of 1.000-10.000 TOE/ year. As the majority of the representatives are very high energy-consumers, it can be assumed that smaller industries do not join associations. Additionally, this can be taken into account in the further analysis of the survey's result presented below.

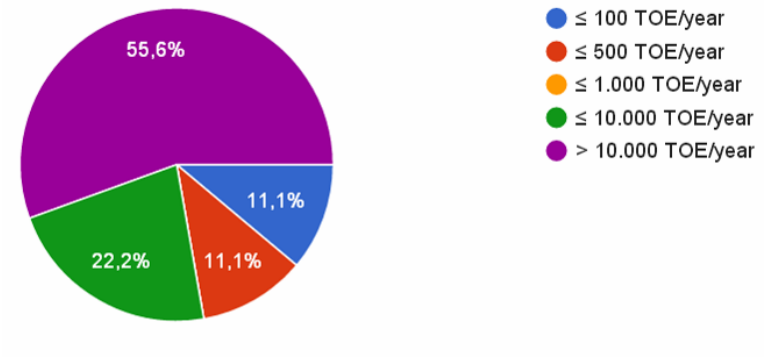


Figure 71: Yearly overall electricity consumption of the associated companies (100TOE= 1,16 GWh)

As seen in Figure 72, 28.6% of companies' thermal energy consumption is more than 100% of their electricity consumption, while the remaining companies are equally divided to 14% of the total of the participants.

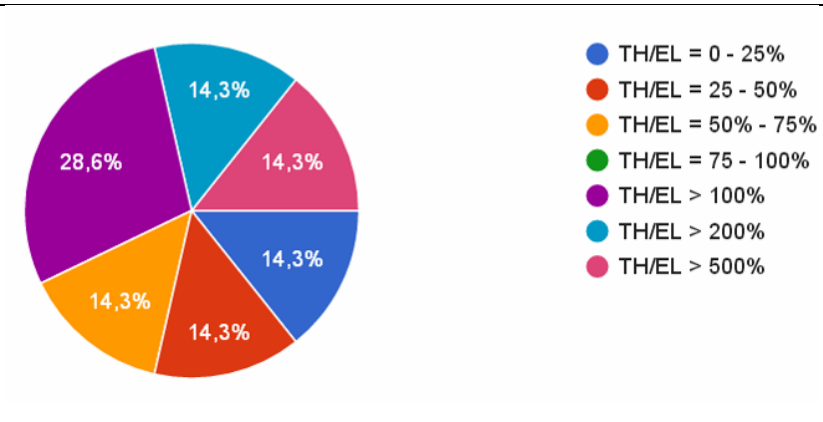


Figure 72: Average relative share of thermal energy (TH) and electric (EL) energy used in the represented companies' processes

Figure 73 shows the percentage of companies equipped with a system for self-production of energy for electricity production (a) for thermal production (b) and for cogeneration (c). It was an "open answer" question. Most of the associations state that around 20% of their members companies produce their own electricity. Figure 73b shows the percentage of thermal energy that industry associations claim their member companies produce themselves. Most of the associations stated that 15% of their member companies are equipped with a cogeneration system, as can be seen in Figure 73c.

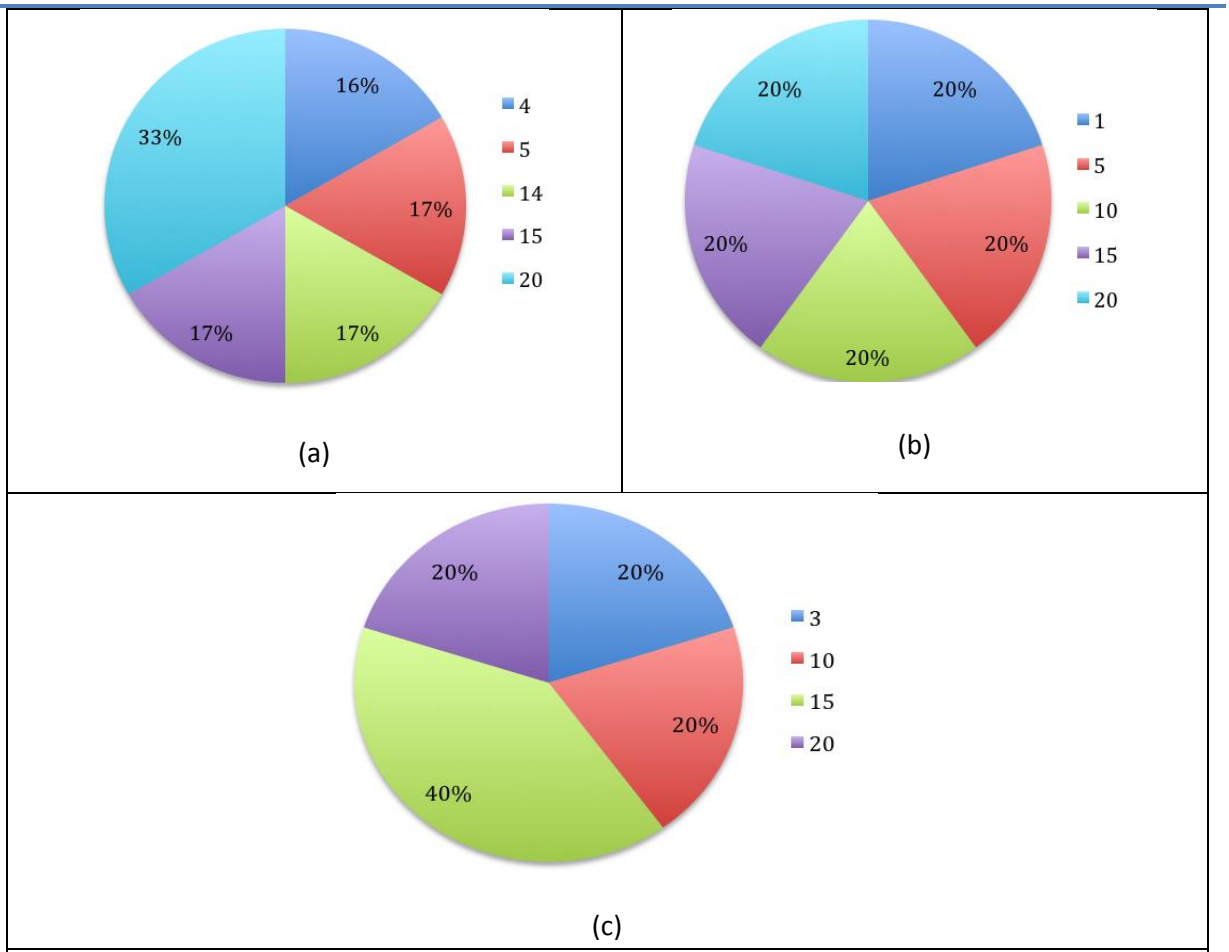


Figure 73:
(a) The percentage of companies equipped with a system for self-production of energy for electricity production (%)
(b) The percentage of companies equipped with a system for self-production of energy for thermal production (%)
(c)The percentage of companies equipped with a system for self-production of energy for cogeneration (%)

4.4 Energy Efficiency approach

Most of the members companies have participated in an energy efficiency support scheme as a voluntary party, followed by companies, which are participating under an Obligation Schemes, such as the white certificates. The remaining participants are either participating as an obligated party or to other energy efficiency support schemes (such as feed- in tariffs).

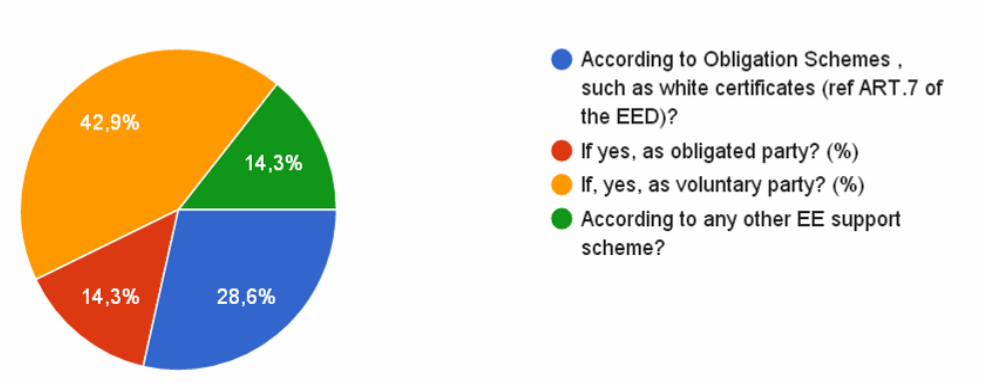


Figure 74: Participation to any Energy Efficiency support scheme (such as energy efficiency obligations, grants, feed-in tariffs, tax credit/deductions, guarantee funds, etc.) of the represented companies

The majority of represented companies have undergone an energy audit of their processes in the last 5 years organized by external experts, as shown in Figure 75.

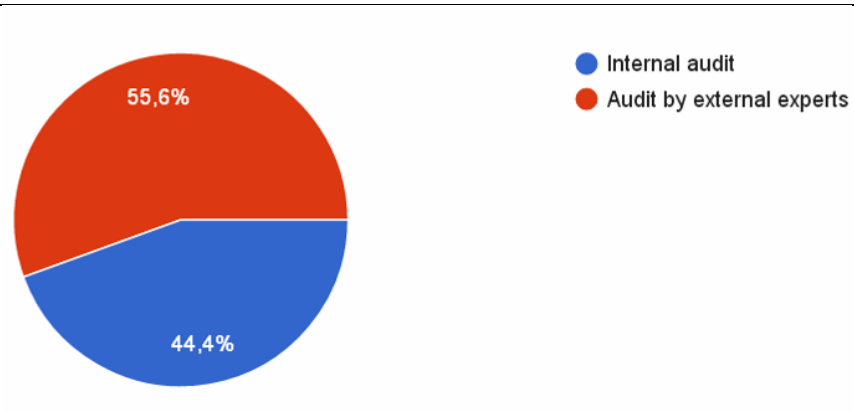


Figure 75: Percentage of represented companies that under took energy audits of their processes in the last 5 years

The vast majority of associations do not provide direct assistance to their members in the implementation of energy efficiency measures. Support was provided via the "organization by the association of meetings regarding knowledge transfer" and the "initiation of research to evaluate new technology and stimulate innovation".

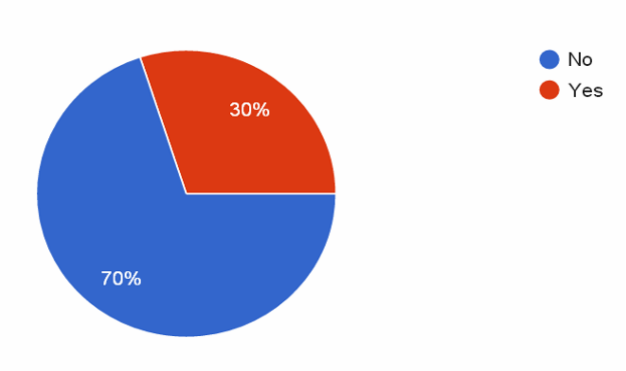


Figure 76: Direct assistance of the associations to their members in the implementation of Energy Efficiency measures

Most of the associations stated that all of their member companies have appointed an energy manager. Since this had been an "open answer" question, the other percentages have been equally distributed as shown in the following figure.

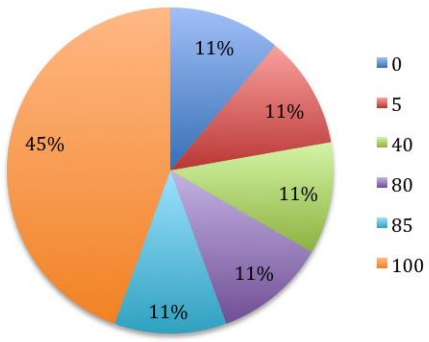


Figure 77: The percentage of companies with appointed energy manager

The 66% of associations either do not know the percentage of their companies that are certified by ISO 50001, or are sure that their companies are not certified.

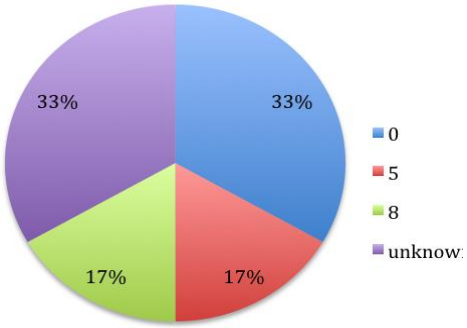
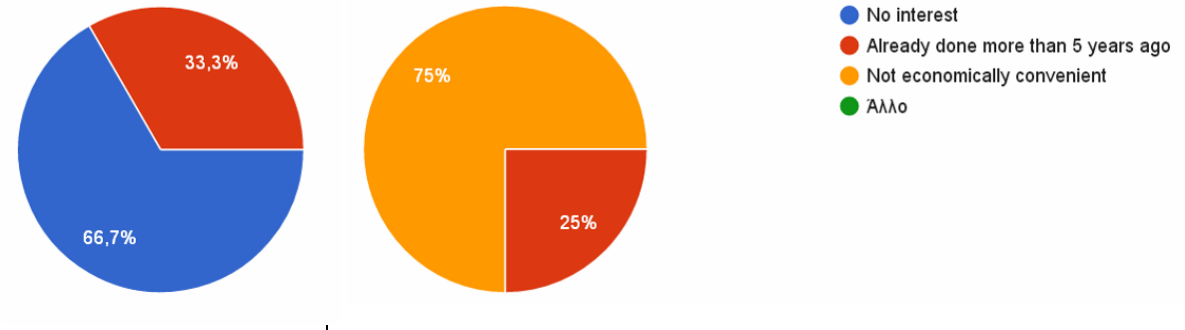


Figure 78: Percentage of companies certified to ISO 50001

4.5 Motivations towards Energy Efficiency measures

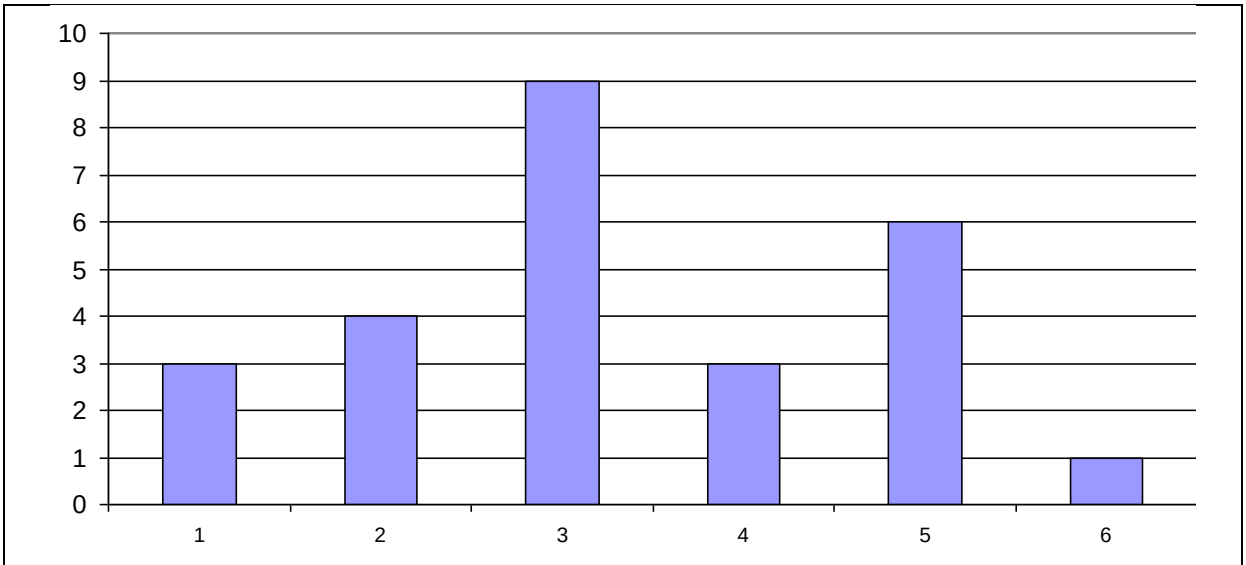
Most of the member companies have implemented energy efficiency measures in the last two years. The main given reason for companies explaining why not having implemented measures was economic inconvenience or because they had already implemented measures more than five years ago.



(a) (b)

Figure 79: (a): Implementation of Energy Efficiency measures in the last two years by the represented companies (YES: bleu, NO: red).
(b): Reasons for not implementing EE measures in the last two years.

The main motivation for investing in energy efficiency measures was the reduction in energy costs, followed by the promise of an improvement in business attractiveness through an enhanced sustainability of the products/services, manufacturing process and value chain. Legal obligations were also considered to be a key driver for a smaller percentage of companies, as well as the ageing of the equipment and a reduction of production costs.



1: Ageing of the equipment
2: Legal obligations
3: Reduction of energy costs

4: Reduction of production costs
5: Improvement of the core business attractiveness through an enhanced sustainability of the products/services, manufacturing process and value chain
6: Other

Figure 80: Main motivation of the associated for investing in energy efficiency

Most of associations represent companies that believe that increasing their energy efficiency can bring them a competitive advantage and improve the reputation of their company, as it is shown in the answers presented in Figure 81.

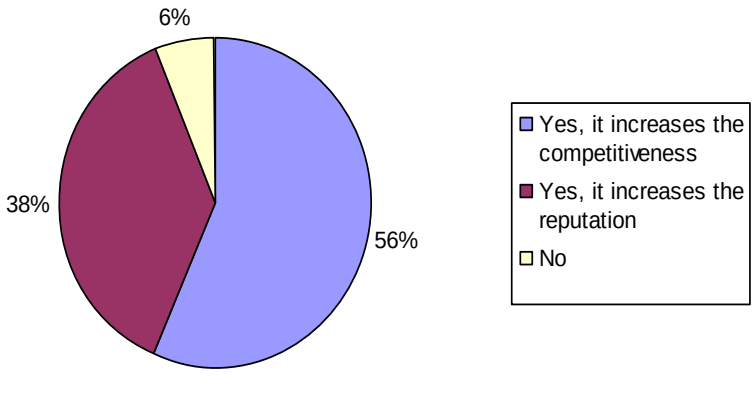


Figure 81: Belief that action on energy efficiency can bring a competitive advantage and improve the reputation of the company

4.6 Technical description of EE measures

Most associations stated that their member companies have chosen to implement energy efficiency measures in the manufacturing processes of their products/services in order to reduce their energy consumption. The next popular measure, as demonstrated in Figure 82, were interventions to services and infrastructure, followed by interventions to the management and organization of production and work. Interventions to the company's buildings are the least preferred energy efficiency measures.

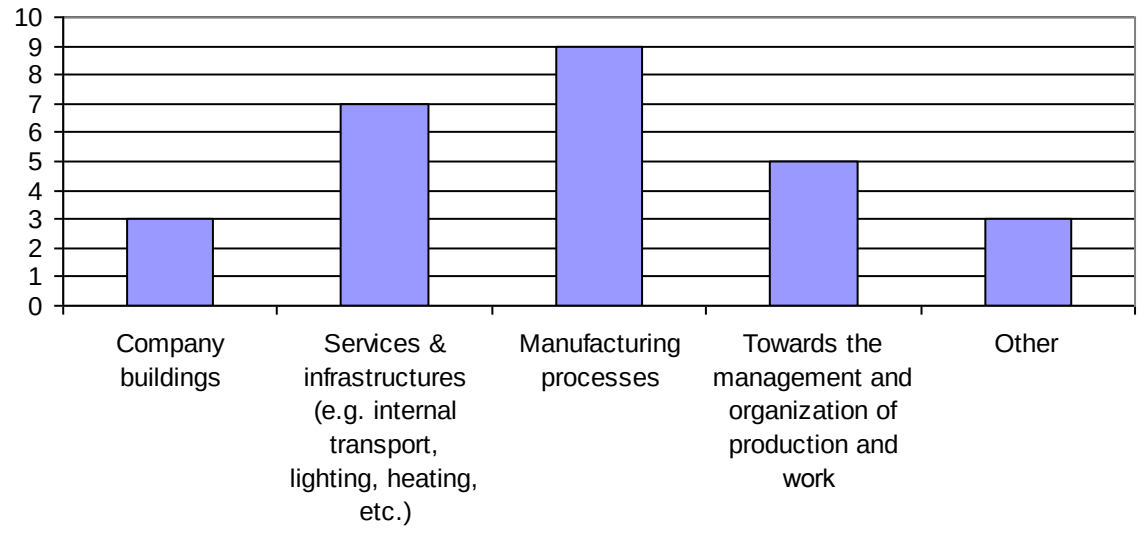


Figure 82: Energy efficiency measures which are mainly carried out in your sector to reduce energy consumption

The specific interventions applied to the manufacturing process were further analysed in Figure 83, which shows more specific solutions adopted by the associations' member companies to achieve energy savings. The most popular intervention was to invest in energy consumption systems, followed by the use of high efficiency electric motors and the investment in energy management systems. None of the companies have invested in a tri-generation plant, whilst an investment in cogeneration was the third most popular choice.

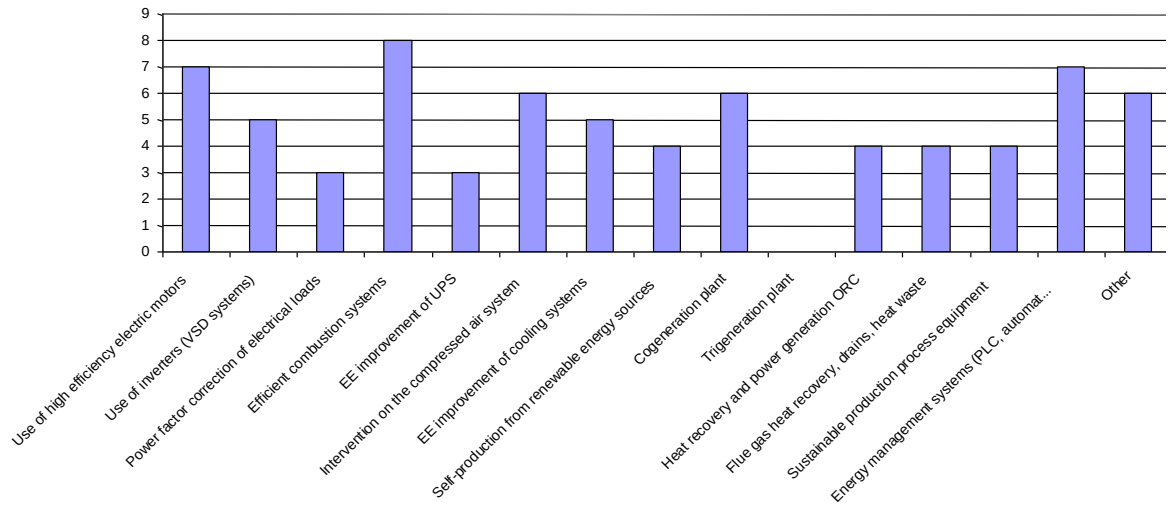


Figure 83: Concerning manufacturing processes, adopted solutions in the associated companies in the field of energy efficiency (multiple choice)[2]

[2]The options in order of appearance have been: *Use of high efficiency electric motors, Use of inverters (VSD systems), Power factor correction of electrical loads, Efficient combustion systems, EE improvement of UPS, Intervention on the compressed air system, EE improvement of cooling systems, Self-production from renewable*

4.7 Level of satisfaction from the implementation of EE measures

All companies have seen a reduction in their annual energy bill as a result of the implementation of energy efficiency measures, mostly around 10% of their total energy bill and 44.4% of companies saw a reduction of 5% of their total energy bill.

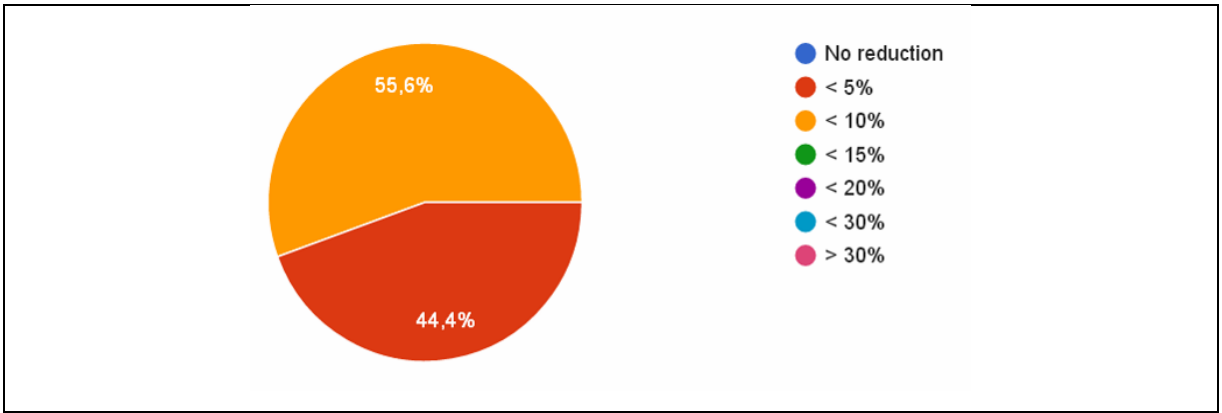


Figure 84: Average reduction of the annual energy bill as a fallout of implementation of energy efficiency measures

These results have been generally in line with the expectations of companies: 50% of the trade associations declared that their participants had achieved more than the 50% of what they had expected to achieve. The other participants had also achieved their initial goals either fully or partially (i.e. less than 50% of their initial target). Only 10% of industry associations declared that their member companies had not reached what they had expected in terms of energy reductions. The associations are from the energy sector (1 of biogas, 5 of energy consumers or agency), food industry (4), telecommunications (1), wood and furniture (1), rubber and plastic (1).

energy sources, Cogeneration plant, Tri-generation plant, Heat recovery and power generation ORC, Flue gas heat recovery, drains, heat waste, Sustainable production process equipment, Energy management systems (PLC, automation ...), Other

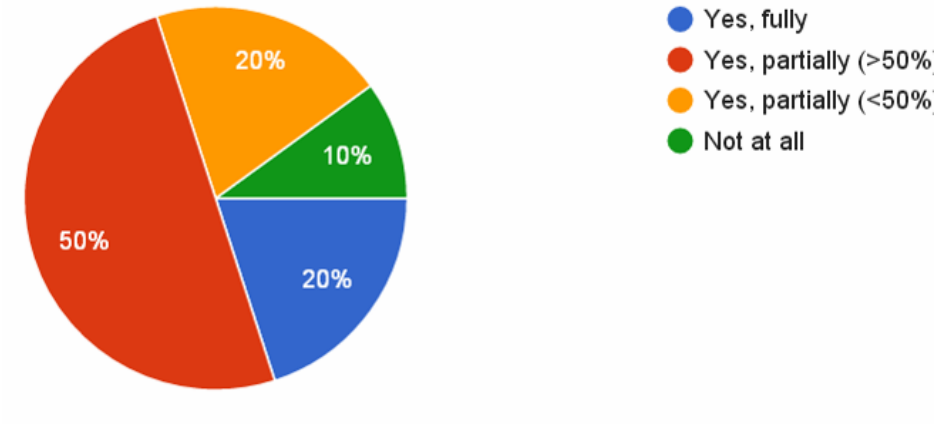


Figure 85: Did you achieve the energy reductions that you expected?

Hence, the vast majority of associations have declared that they received good feedback from their member companies, and 30% of associations even received excellent feedback. Only 10% of associations stated that their members were not satisfied.

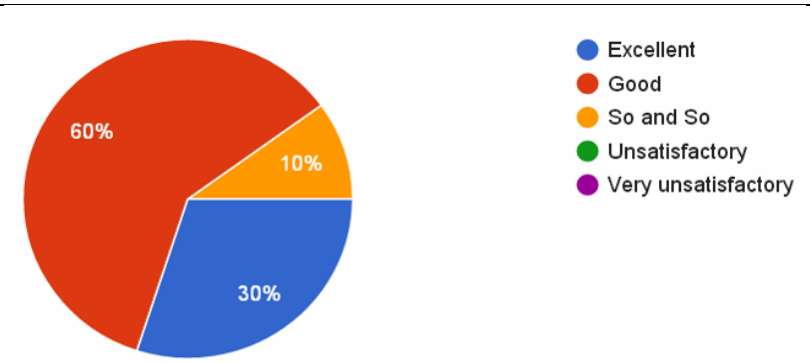


Figure 86: What's your feedback on the efficiency path taken by your associated

4.8 Economic feasibility of energy efficiency investments

The vast majority of the member companies do consider the cost needed for the investment as a decisive factor for implementing energy efficiency measures.

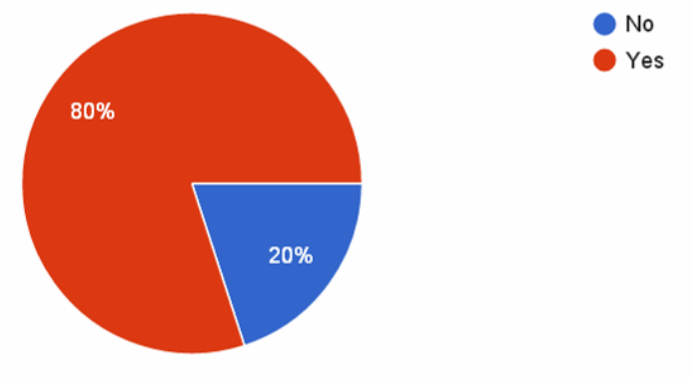
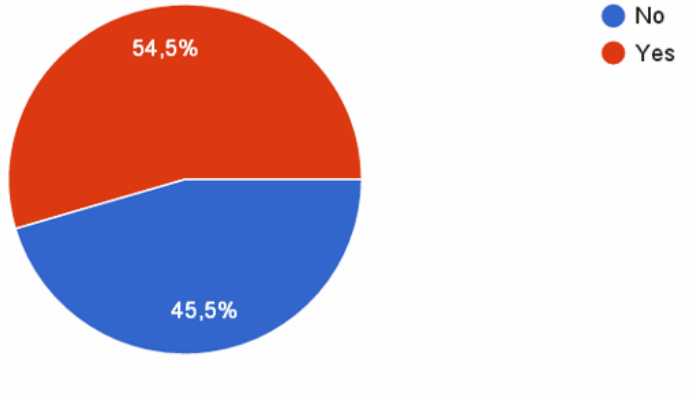
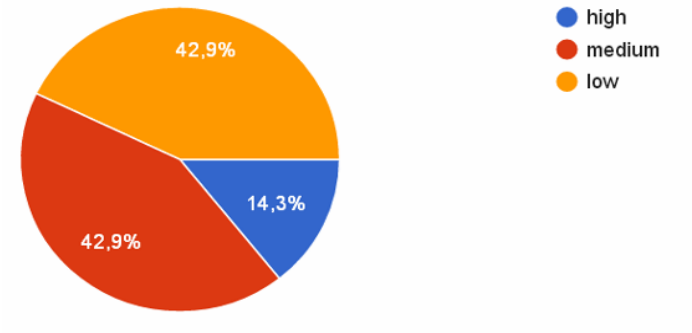


Figure 87: The energy investment cost as decisive factor for implementing energy efficiency measures in your associated companies

Furthermore, the majority of member companies consider the operational and maintenance cost of the energy efficiency investments as only a medium or low-level barrier to the investment in energy efficiency measures and even fewer (14.3%) see it as a high-level barrier.



(a)



(b)

Figure 88: (a) Are operational & maintenance cost of energy efficiency investments considered a barrier in for your member companies?
(b) If yes, at which level?

The next question further examines the above-mentioned barriers. As seen in Figure 89, 55% of companies finance their interventions using their own capital. Fewer have financed interventions via European Union projects (17%) or loans (17%), and even fewer have used structural funds (11%).

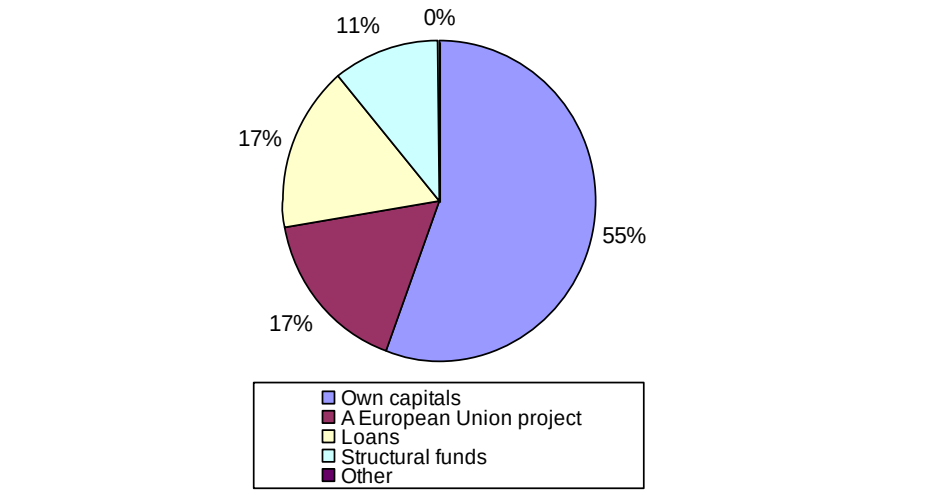


Figure 89: Finance opportunities of the energy efficiency measures

A more detailed analysis of the instruments used to finance energy efficiency measures is shown in Figure 90. The 50% of member companies used subsides, while the remaining companies made use of tax incentives (20%), other options, not mentioned in the given answers (20%), and feed in tariffs (10%) for the produced heat and/or electricity. Finally, most of the member companies are located in countries where the support of energy efficiency projects is not a usual official bank-policy, as shown in Figure 91. These Associations are located in the Netherlands (2), Italy (2) and Romania (1).

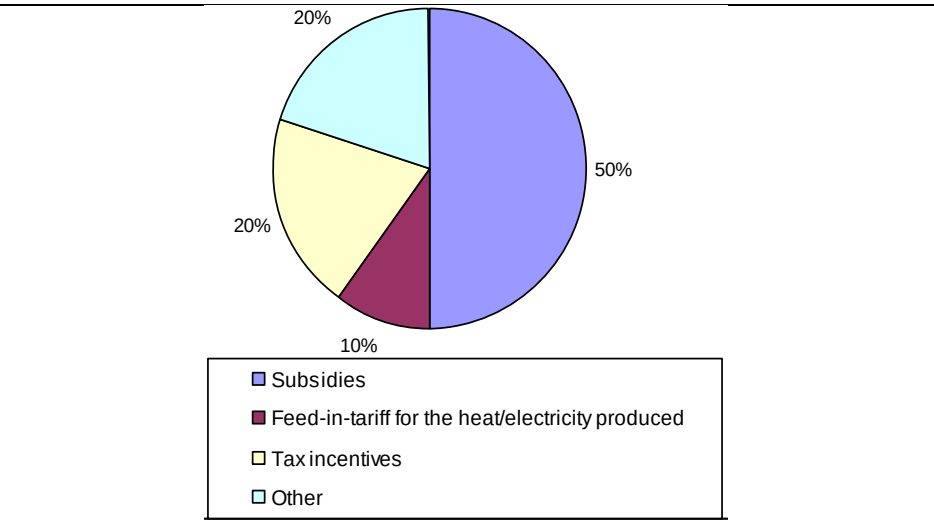


Figure 90: Financial instruments usually used in order to support the energy efficiency investment

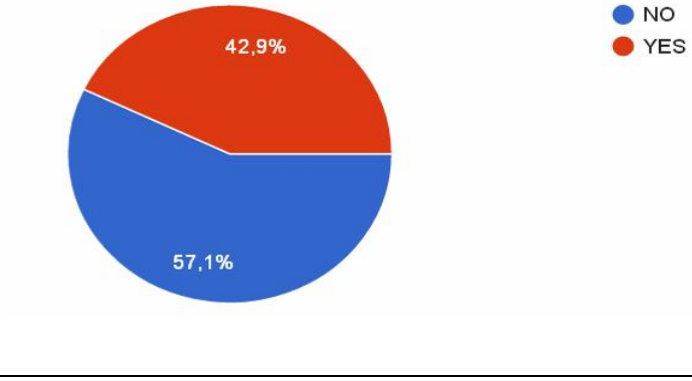


Figure 91: Is the support of EE projects usually an official bank-policy in your country?

4.9 Economic and procedural barriers of energy efficiency measures

Figure 92 shows what industry associations perceive to be the key obstacles that hamper or reduce the investments in energy efficiency for their members. Most companies have indicated a long payback period as the most important barrier.

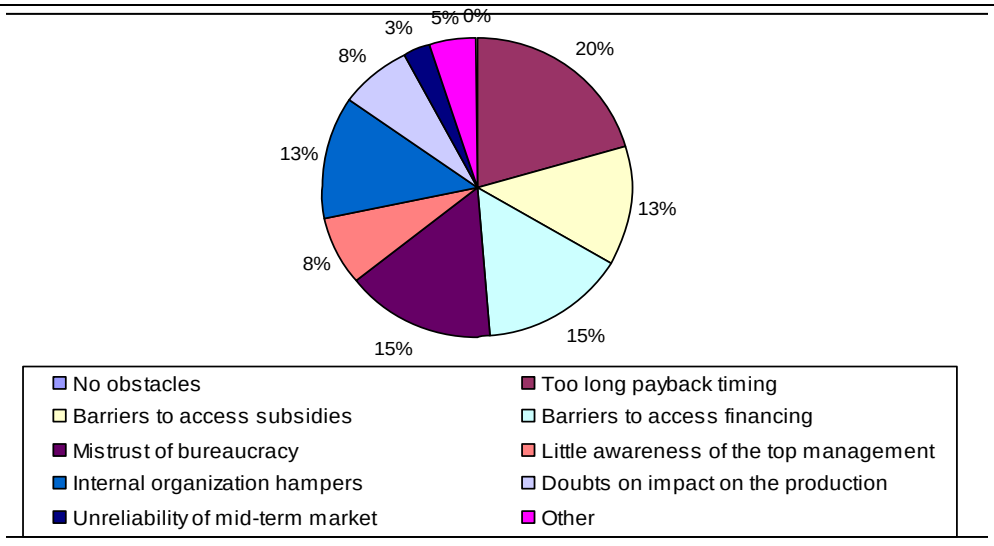


Figure 92: In your opinion, what obstacles hamper or reduce the investments in energy efficiency

Figure 93 is related to Figure 94, as it asks associations to rank factors that could encourage their members to implement energy efficiency measures. Investment subsidies have been declared to be the most important factor in encouraging investment in energy efficiency, while the familiarity of the bank with energy efficiency projects is considered to be the least important one.

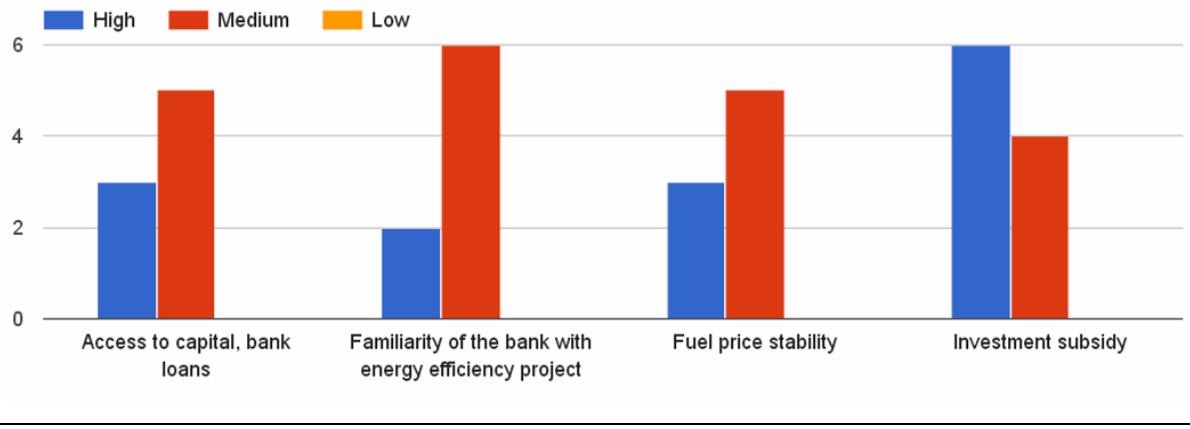


Figure 93: Importance of factors for investing in Energy Efficiency Measures

Figure 94 shows how the associations valorize the different barriers for the implementation of energy efficiency measures. The results show that the *procedures, time and costs for researching the most effective technology* has a different meaning for different companies, as it has been ranked as being of high, medium and low importance. However, this factor has also been declared to be the most important barrier by the majority of associations. On the other hand, most of the associations have pointed out that the "*procedures, time and costs for submitting an application for adopting this technology making use of the specific policy*" is the least important barrier for the implementation of energy efficiency measures.

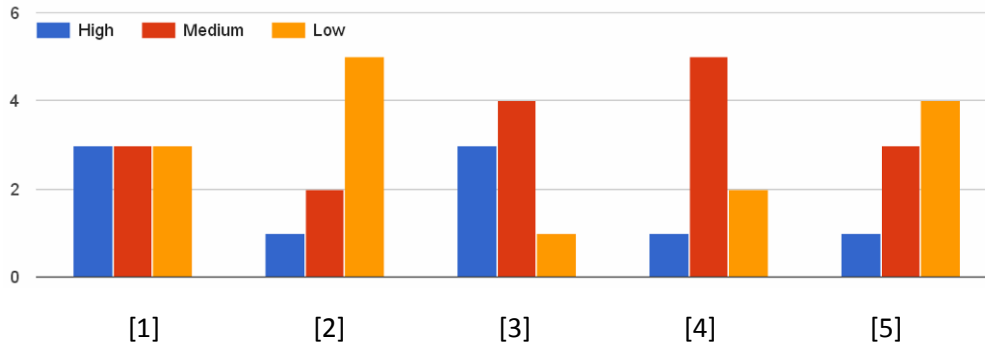


Figure 94: Importance of factors considered as barriers for implementing energy efficiency measures
[1]: Procedures, time and cost for researching which technology fits best, for the E.E. measure
[2]: Procedures, time and cost for submitting an application for adopting this technology making use of the specific policy
[3]: Procedures, time and cost to get the grand
[4]:Procedures, time and cost to implement the measure
[5]: Procedures, time and cost for providing data for monitoring the consumption of the policy

4.10 Organisational feasibility for implementing energy efficiency investment

In order to assess the organisational feasibility of energy efficiency investments, the associations were asked to evaluate how important specific factors are for the positive development of energy efficiency measures. The most important organisational factor required for the successful implementation of energy efficiency measures, is the availability of knowledge on all the available solutions, an encouraging regulatory framework and the stability of frame conditions (RES-targets, incentives...). The least important factor by far is the social acceptance of the measure.

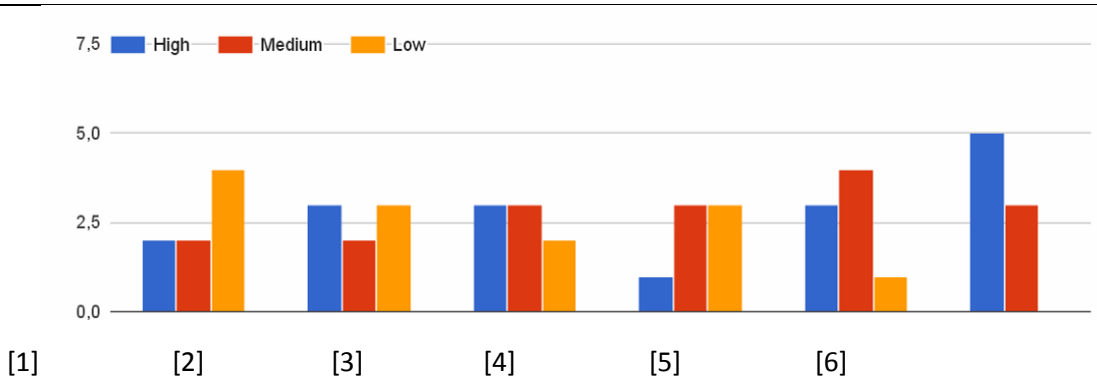


Figure 95: Which factors are of high importance for the positive development of the Energy Efficiency Measures in your association branch?

[1] Employment creation
[2] Availability of Information/ advice
[3] Availability of service of experts
[4] Availability of ESCOs
[5] Knowledge of your company's energy consumption
[6] Knowledge of the available solutions
[7] Availability / Ability of your engineers
[8] Improvement of your products/services due to the investment
[9] Social acceptance
[10] Regulatory frameworks
[11] Stability of frame conditions (RES-targets, incentives...)
[12]Contracting solutions availability

5 Costs of implementing EEOs and other policies in industry

5.1 General information about the efficiency of EEOs in the EU

An important element of the EEOs addressing industry is the procedure for payment of the related costs needed to achieve the targets in the form of cost recovery mechanisms, which affect the overall efficiency of the schemes. As the IEA (2017)[3] study demonstrates, it is often the case that about one-third of the cost of installed measures will be paid by the programme administrator or obliged entity (Rhode et al., 2015; Molina, 2014[4]).

The efficiency of the EEOs has been reported in detail in the ENSPOL project, where schemes of various countries had been registered and analyzed. The most common and general ways of dealing with the costs are: the identification of a price mechanism, like a regulation or an exchangeable certificate, and the open option to choose from various possibilities the way each EU energy market will design its scheme. The main factor which defines the measures is the existence of regulated or non-regulated energy markets and respective prices.

In the case of regulated markets, it is quite often that the regulators support the energy providers through specific mechanisms in order for the latter to undertake the costs needed to implement energy efficiency measures for achieving their targets. Furthermore, the regulators offer a relevant amount, which is meant to cover the loss of income resulting from reduced energy sales, expected from the more efficient energy consumption. A usual way of achieving this is an energy tariff threshold.

In contrast, in non-regulated markets, usually the energy retailers are responsible for the implementation of the obligations. A common cost recovery option there is to pass full or a fragment of the additional costs to the final energy consumer by including the investment cost to the final energy bill. One other popular option is to turn for financial support to governmental funding schemes.

5.2 Approaches of the cost recovery mechanism of EEOs in the EU

There are similarities and differences in the cost recovery mechanisms of the EU MS. In the following Table data has been gathered from the ENSPOL 4th Policy brief report and has been homogenized in

[3] IEA (2017), Market-based instruments for energy efficiency – Policy choice and Design. Insights Series 2017

[4] Rohde, C., Rosenow, J., Eyre, N (2015), Energy saving obligations: Cutting the Goardian Knot of leverage? Energy Efficiency 8(1), pp.129-140

Molina, M. (2014), The best value for America's energy dollar: A national review of the cost of utility energy efficiency programs. Report Number U1402. ACEEE. Retrieved from: http://aceee.org/sites/default/files/publications/researchreports/u1402.pdf.

the respective countries which are applying the same mechanism. Some cases, like Italy and Denmark have followed a more complicated mechanism, which differs in the case of power, gas, district heating, oil companies (Denmark's case) or it depends on the previous year's market values (Italy). In both cases, the inclusion is in the *tariff*, which is similar to the case of Latvia and Malta, whilst the other countries are increasing the energy prices. The table below summarizes the cost recovery mechanisms in the EEO (existing and planned ones in the EU, (source Broc 2015[5], ENSPOL 2016)

Table 2: Cost recovery or funding mechanism by country

Country	**Cost recovery (or funding) mechanism**
Explanations	*are obligated parties allowed to recover their expenses due to the scheme? (and how?)*
Austria	Liberalized energy market and suppliers can recover costs through increasing energy prices
Bulgaria	Not defined yet, which is likely one of the main reasons of the low achievements so far
Croatia	Cost recovery with regulated price of energy distribution which will take into account additional costs due to the scheme (possibly industries will be exempted from increase of prices)
Denmark	The cost is recovered by supplement to revenue cap (power, gas) or by inclusion in tariff (district heating), with the exception of oil companies that cannot carry costs to consumers
Estonia	not defined yet (would likely be through energy tariffs, under supervision of the Competition Authority that regulates the energy markets)
France	Liberalized energy market and suppliers can recover costs through increasing energy prices. Special rules applied for the energy suppliers with regulated energy prices.
Greece	Liberalized energy market and suppliers can recover costs through increasing energy prices. Special rules applied for the energy suppliers with regulated energy prices.
Ireland	Liberalized energy market and suppliers can recover costs through increasing energy prices
Italy	Tariff reimbursement for obligated parties depends on previous years market values (since 2013, previously on standard fuel price mix trend). Cost for savings measures in electricity/gas can be included in regulated operator's tariff, whereas this is not possible for transport measures. The Adjustment is under discussion to allow inclusion in gas tariff, or to recycle costs into the transport sector.
Latvia	There is a provision to increase energy tariffs for cost recovery
Lithuania	Not yet defined
Luxembourg	Liberalized energy market and suppliers can recover costs through increasing energy prices. To avoid distortion between energy types, non-obligated suppliers may have to pay a special tax. The obligation is

[5] http://atee.fr/c2e/third-european-workshop-meeting-white-certificates-club

	defined as a mission of public service. This allows the scheme to be partly funded by the public budget.
Malta	The cost recovery option is through the electricity tariffs increase
Poland	Liberalized energy market and suppliers can recover costs through increasing energy prices
Slovenia	Liberalized energy market and suppliers can recover costs through increasing energy prices
Spain	Liberalized energy market and suppliers can recover costs through increasing energy prices
UK	Liberalized energy market and suppliers can recover costs through increasing energy prices

5.3 Approaches of the other countries which participated in the EU-MERCI survey

Additional information has been gathered in order to include all the countries that had participated to the EU-MERCI survey, such as the Czech Republic, Greece, the Netherlands and Romania.

In the Netherlands, the EE policy has a multi- level approach, which included: energy taxation, fiscal regulations giving privileges when energy investment had been made, voluntary agreements for different sectors (industries, services, households etc), financial support for innovation and frontrunners etc. The Dutch policy includes to the cost of measures a) the end- user consumer, since energy taxation is applied, b) the government, since financial and fiscal support is provided and c) the market key- players, through voluntary agreements which enhance reductions to energy consumption.

A different approach is chosen by the Czech government in order to comply with Article 7. The mechanism included to the implication of alternative mainly of financial character. More specifically, a programme had been designed, the "Operational Programme Enterprise and Innovation for Competitiveness", aiming to support energy savings in the industry. Furthermore, another programme had been formed, targeted this time to the households: "Green Savings Programme". Furthermore, benefits are attributed to the implementation of the recommendations of mandatory energy audits, a mechanism which does not include direct financial support. The public sector has taken the role of promoting new energy efficient technologies by the indirect way of demonstration by application.

In Greece the adaptation of the Article 7 of the Directive 2012/27/EU with the implementation of energy efficiency obligation schemes, is estimated to result to 3 332.7 ktoe (38.8 TWh) saved in total. The estimated savings are foreseen to become from the implementation of policies addressed to all the energy consumption sectors. Various programs have been designed which are financing and supporting energy efficiency measures in households, buildings etc., taking under consideration social factors as fuel poverty. A support action has been implemented, in order to monitor the energy efficiency improvement and the energy savings (funded). Financial support has also been given for the investment in energy-saving technologies and research. Tax incentives have been given to final consumers and legal persons when energy saving interventions had been applied. The public

sector has been used, like the Czech Republic, as an exemplary of energy efficiency trends (bioclimatic upgrades), while energy management systems have been implemented, and new development models are being applied to rural areas and islands. In other cases the cost is indirectly transferred to the consumer, through new regulations on the Energy Performance of Buildings.

Romania has decided to apply energy efficiency measures to: primary resources, production, distribution, supply, transmission and final consumption. The funding of the energy efficiency projects in the industry is done by national and European funds, while the implementation of energy efficiency interventions in households had been the responsibility of the Romanian National Program, hence under public funding. Other interventions have also been made through the National Environment Fund budget, while there has been an increase in the taxation system- but not only for energy prices.

In addition to the data mentioned in the table above, Italy has established the White Certificate Scheme which obligates electricity and gas distributors having more than 50,000 end users, to generate each year a certain amount of energy savings. Furthermore, it had been made a promotion of specific energy efficiency intervention with a payback period minor than four years in the industry which had done energy audit. The cost recovery mechanism is left to the carrying over to the electricity and gas customers' bills linked to the energy efficiency trading market. More specifically, this cost is defined by the authority considering the yearly trading market. In 2014 the contribution to the cost was 105.83 E/toe, which increased to 114.83 E/toe in 2015. Considering the rate contribution of 105.83 E/toe, the total economic burden on fulfilling the 2014 target was 617 mEuro for obligated parties. This correlation between the trading market exchange prices of the individual sessions and the definitive tariff contribution is a transparent means for cost recovery, which takes into account the shadow prices of energy efficiency investments (in the form of certificate market prices).

In other countries with a longer experience on EEOs (outside the survey), various cost recovery mechanisms are present. For instance, in France (ENSPOL 2016), despite the absence of public information on their costs, from a 2013 assessment the average obligated parties costs were 0.4cE/kWh cumac, 75% of which was for incentives for energy efficiency actions and the 25% for administrative costs, even though much higher for some of them. The market experience shows that energy suppliers pass their costs directly to consumers, and the figures from the fuel oil showed that energy efficiency from certificates represented a 0.027 E per litre of diesel at the pump in 2016, compared to a 0.04 E increase due to the carbon tax. Still, the issue remains as the new energy suppliers do not wish to increase their prices as they sell below the regulated price. For the incumbent suppliers, the costs are partly covered through a tax on energy bills, where certificates represent 1% of the electricity price for households and 0.5% of the gas price. In Denmark, according to the official evaluation of the EEO carried out by the independent consultancy EA Energianalyse on behalf of the Danish Energy Agency in 2012, investment costs in households were 1.2 €/kWh (9 kr./kWh) while other sectors had an average investment cost of 0.11 €/kWh (0.80 kr./kWh). The surcharge on the energy prices has been estimated by the DEA for 2013-2015 as (in c€/kWh) 0.23 for electricity, 0.17 for gas, 0.2 for district heating and 0.04 for oil.

5.4 Cost estimations of EEOs and energy efficiency policies in industry

The costs of the EEOs and the other policies addressing industry, in order for the MS to comply with the Art. 7 targets of the EED, vary significantly and very few studies have carried out ex-post evaluations thus far. Some basic estimates, as from the IEA (2017) study come up to the fact that drawing conclusions on the cost-effectiveness of different obligations is challenging as the evaluation methodologies adopted in each country for accounting costs and savings are not consistent. The main problems identified are:

- Some countries discount energy savings whereas others do not.
- Estimates for free-ridership vary across countries.
- Rebound effects are taken into account to different degrees.
- Lifetimes of measures are not always the same.
- Some evaluations are ex-ante, others ex-post. The rigor is not the same across all countries.

Based on this study, programme costs and savings for several EEOs globally were calculated, where the median programme cost is 0.019 USD/kWh lifetime savings and the average weighted by the reported energy saved is 0.013 USD/kWh, which are all below the average energy supply costs, rendering thus these policies highly cost effective (as shown in Figure 96).

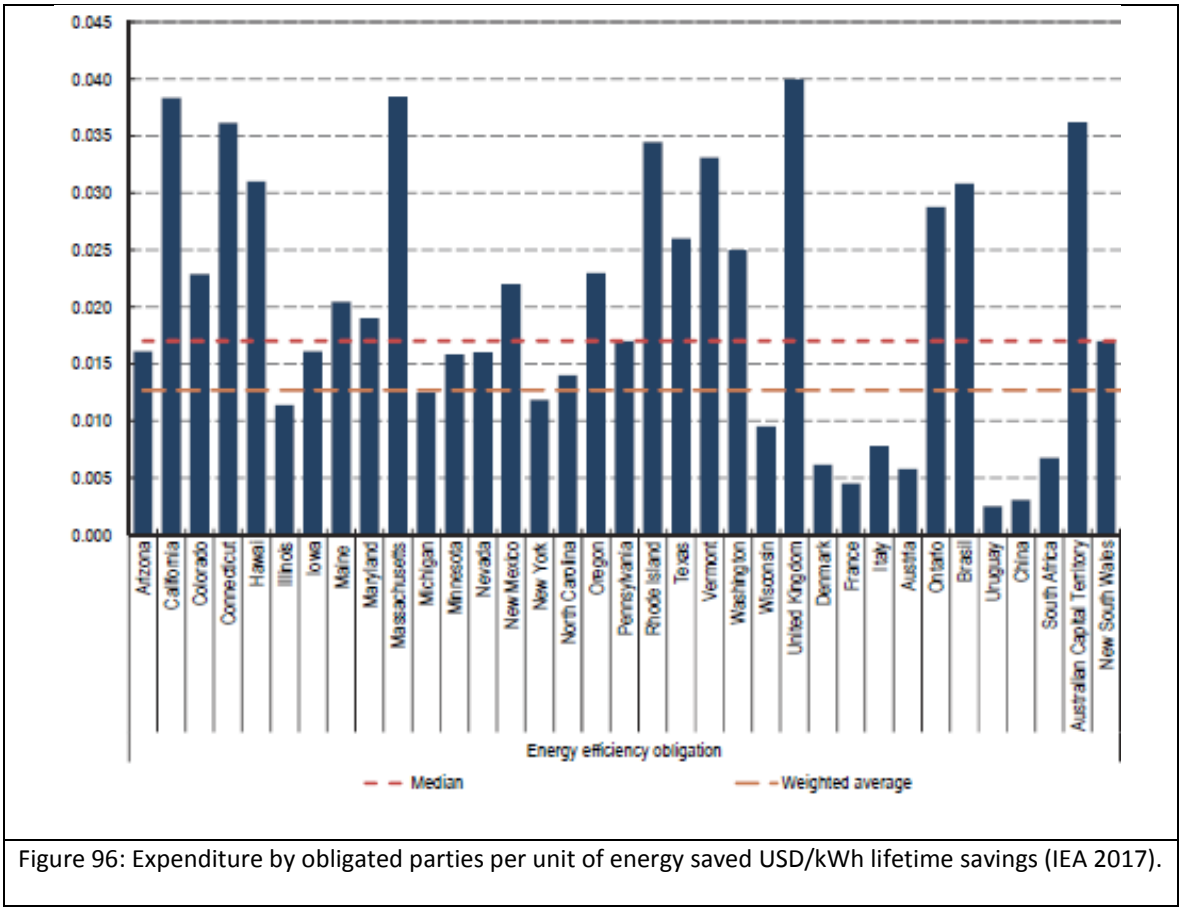


Figure 96: Expenditure by obligated parties per unit of energy saved USD/kWh lifetime savings (IEA 2017).

In another study, an evaluation carried out by RAP (Rosenow and Bayer 2016[6]) on the costs of EEOs has categorized these costs as program, societal, administrative and start-up costs. Again, the costs of schemes differ substantially due to the nature of these costs and the ways they are calculated. From the energy company perspective (as obligated party), the contribution to energy efficiency projects depends on the types of measures and customers, but in general almost every €1 of funding leverages €2 to €3 of private investment.

For some EEOs that have dealt with industry, the costs carried out by the companies (obliged parties) and the administration (administrative costs) are reflected below (RAP 2016):

Table 3: Obligated parties costs and administrative costs

Country	Obliged party costs (ME/ year)	Administration costs (% of program costs)
UK	1,052	0.2
Denmark	185	0.3
France	390	0.4
Italy	700	1.4
Austria	95	n/a

Based on these estimations, the EEO costs compared to the energy prices makes them rather cost effective and the costs of energy savings are much lower. The cost to the obligated company per kWh of energy saved in Europe is approximately 0.4 to 1.1 euro cents, which is significantly less than the cost of energy (as shown in the table below, RAP 2016)

Table 4: Weighted average costs of EEOs and retail prices

Country	Weighted average EEOs cost of lifetime energy savings (Ecents/kWh)	Weighted average retail prices of comparable energy supply (Ecents/kWh)
UK	1.1	10
Denmark	0.5	13
France	0.4	9
Italy	0.7	9

The cost of the implementation of these schemes is almost one fifth of the total average energy bill received by the industrial sectors, which, if compared to the overall savings is a quite low amount.

[6] Rosenow, J. and Bayer, E. (2016) Costs and benefits of energy efficiency obligation schemes, The Regulatory Assistance Project

Indicatively, in Denmark the cost of the EEOs as a share of the energy bill is 5% and in Austria 0.9-1.4% assuming a 100% cost pass through to the industry.

In terms of transaction costs of the energy efficiency policies as a whole, there is even less literature available (whereas the most recent studies date a decade already, see for instance Mundaca 2007[7]). Some evidence from industry (Ostertag 1999)[8] demonstrates that transaction costs amount to only 3-8 % of investment costs and are by far not important enough to outweigh the no-regret potential

5.5 Cost estimations from the EU-MERCI survey

In the survey conducted under EU-MERCI, industrial companies declared the way they had designed their own energy efficiency strategies. 47% of the respondents have adapted their strategy to Obligation schemes, while a significant 33% have done it independently. An analysis per country is presented below.

In **Bulgaria,** 71% of the survey participants have not worked in any support scheme, while the vast majority of the participant companies have financed their energy efficiency measures by their own capitals. The most important barriers for the investment on EE measures had been equally the access to subsides, the mistrust of the bureaucracy and the long pay-back time.

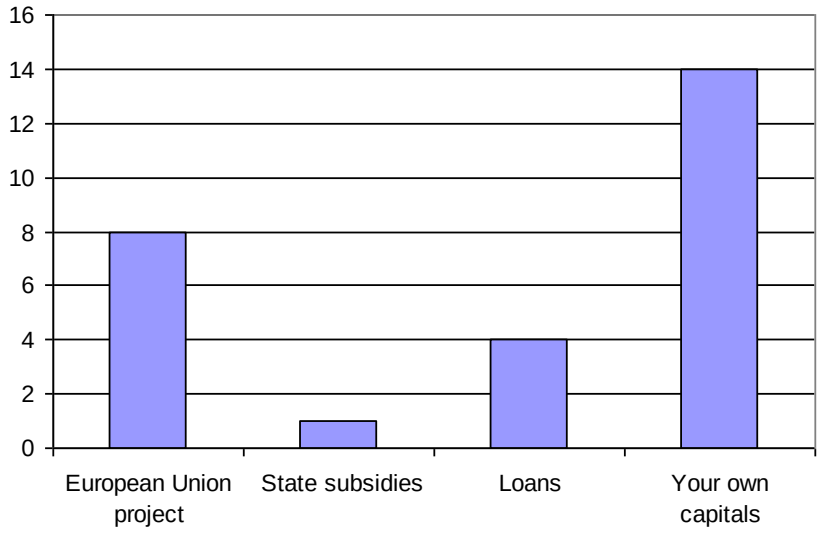


Figure 97: Financial of energy efficiency measures in Bulgaria

[7] Mundaca (2007) Transaction costs of tradable White Certificate schemes: The energy efficiency Commitment as a case study. Energy Policy 35(8)

[8] Ostertag, K. (1999) Transaction costs for raising energy efficiency. Working paper (IEA International Energy Workshop on Technologies to reduce GHG emissions, 5-7 May 1999, Washington)

In **Czech Republic,** 67% of the survey participants have financed the energy efficiency measures by their own capitals and a 33% by loans, while 86% have not participated to any support scheme. Nevertheless, there is an interest from most of companies in using of subsidies for the financial support in the future, or of the feed-in-tariff for the heat/electricity produced, from a smaller portion of the participants. It is interesting to notice that in the question of the definition of the way of their future investment scheme, only 20% of the participants answered that they will prefer structural funds, while the others will equally prefer the use of loans or their own capitals. This is in line with the answer provided to the question related to the obstacles that hamper investments in energy efficiency, which had been declared by the vast majority the barriers to access subsites. The option of EU funding or support schemes does not appear in the answers. However, the policy that grants benefits to the implementation of energy audits seems to have proven effective, since 67% of the participants have implemented energy audits, either internal (45%) or by external experts (22%). Another result of the survey is that the 60% of companies, which had not applied energy efficient measures in the past five years justified that they had no interest in doing so, while the other 40% blamed the economic inconvenience. This could signify that there is a need of more awareness in energy efficiency in industry.

The survey results from **Greek** industries have pointed out that the most important obstacle for the implementation of energy efficient measures is the long payback time. Only 30% from the respondents declared that the main barrier is the access to finance, although there is also a smaller portion (14%), which doubts on the impacts on the production. Almost all participants have conducted energy audits. Furthermore, most (67%) of the participated industries have financed the energy efficiency measures by their own capitals and almost all of them are willing to do so in the future. A smaller part had used loans (16%) and EU projects (17%). Subsidies also appear as an option of a future financial support instrument, however most of the answers declared that are not willing to make use of any financial instrument at all.

The survey results concerning the **Italian** industries have proven that the energy audit measure was successful, since all companies carried out energy audits, either by internal or external experts. Additionally, the vast majority (90%) of the participated industries had carried out energy efficiency measures in the last five years and half of those who had not, it was because they already had done so a bit earlier- hence, we can assume that this was due to the application of the respective energy efficiency policy measure (see above).

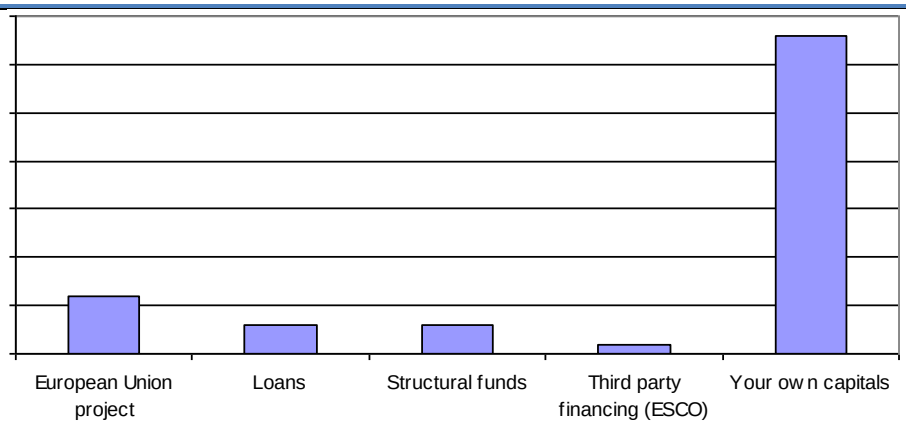


Figure 98: Financial of energy efficiency measures in the past (Italy)

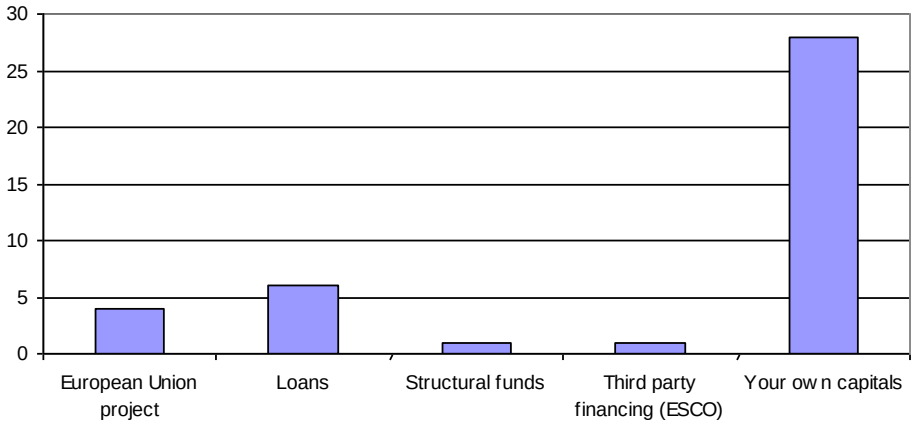


Figure 99: Ways of financing of energy efficiency measures in the future (Italy)

It is worthwhile reflecting on the Italian industry responses to financing of the energy efficiency measures in the past and in the future. The vast majority of the participants had used their own capitals for the funding of the implementations of the measures and intend to do so in the future. In the scheme below, however, it is proven that the subsidies and the tax incentives are the most popular financial supporting instruments, both for the past- as for the already done investments- and for the future ones. The feed-in-tariff is the third more popular measure, with significant percentage of the pies in both cases.

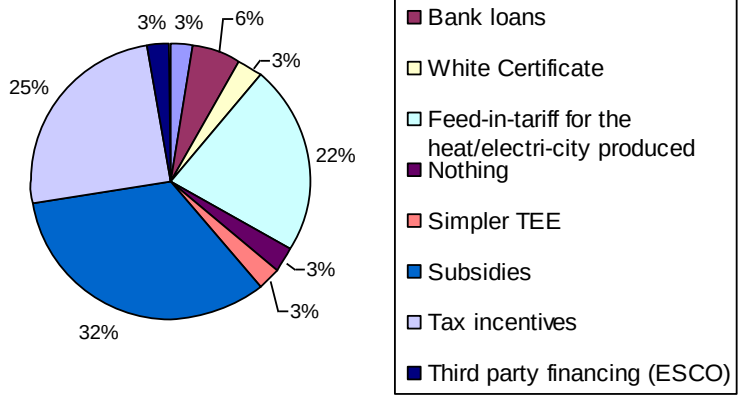


Figure 100: Types of financial instruments used in the past in order to support energy efficiency investment in Italy

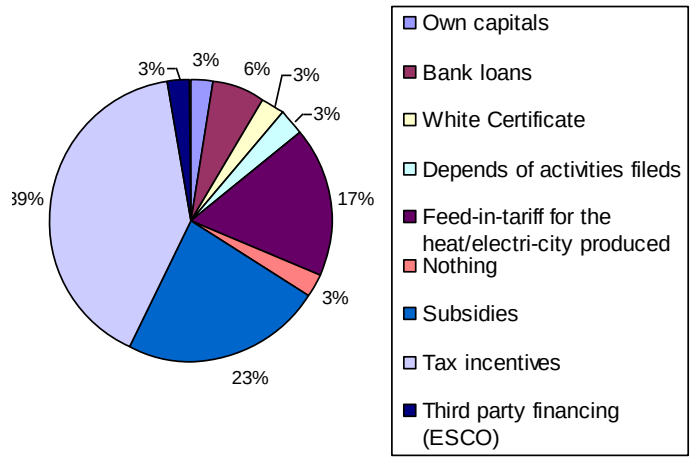


Figure 101: Types of financial instruments used in the future in order to support energy efficiency investment in Italy

In the **Netherlands** the chosen policies seem to have been proven effective and to give the desirable results. For instance, all of the industries, which had contributed to the survey, had participated in Energy Efficiency support schemes: the 39% as a voluntary party, the 23% as obligated party, the 15% to the national programme MJA, while another 15% to other EE support scheme. The 8% had participated according to Obligation schemes. All of them had carried out energy efficiency measures in the last five years and the vast majority has conducted an energy audit. As in the case of the other counties, most of the industries have financed the measures by their own capitals in the past and are willing to do so in the future. The use of loans had been the next popular option in the past, followed by the exploitation of structural funds. Concerning the future potential financing options, after the use of their own capitals (being the first option), an interest for application for loans and European Union projects has been declared. When it comes to financial support from governmental instruments, most of the industries had preferred subsidies and tax incentives in the past and it is declared that these shall also be preferred by the majority in the future.

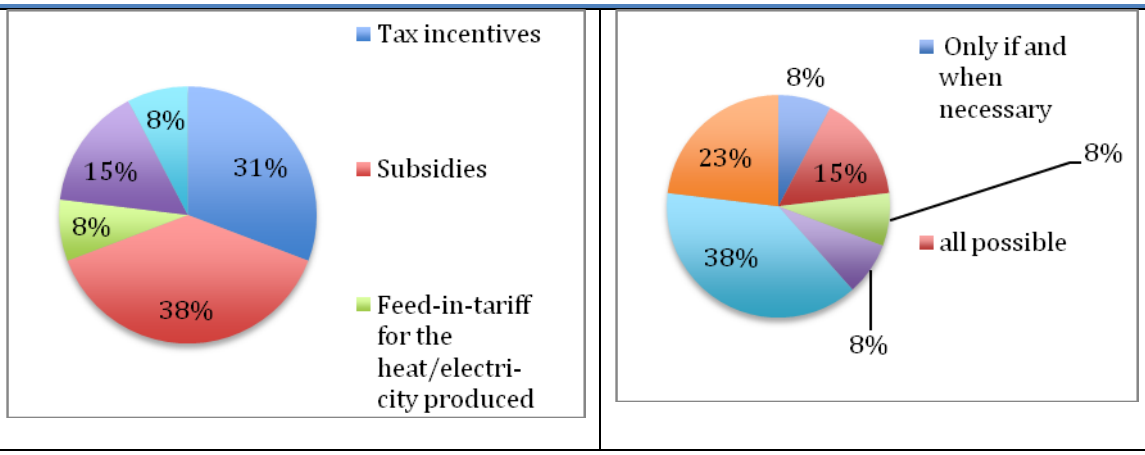


Figure 102: Types of financial instruments used in order to support the energy efficiency investment in the past (left) and in the future (right) in the Netherlands

In **Poland** most of the industries have participated to EE support schemes according to Obligation Schemes, and less as a voluntary party. The majority had proceeded to the implementation of energy efficiency measures the last five years, and most of the industries had financed them by their own capitals. As a financial instrument, it seems that the subsidies and the structural finding have been the most popular option, both in the past as well as in the future.

Concerning **Slovenia**, only a few industries had participated to the survey. However the ones that had shared their energy management had declared a clear preference for the application of the subsidies as a support mechanism both for the past and for the future. In the following figure is shown the participation for EE support schemes.

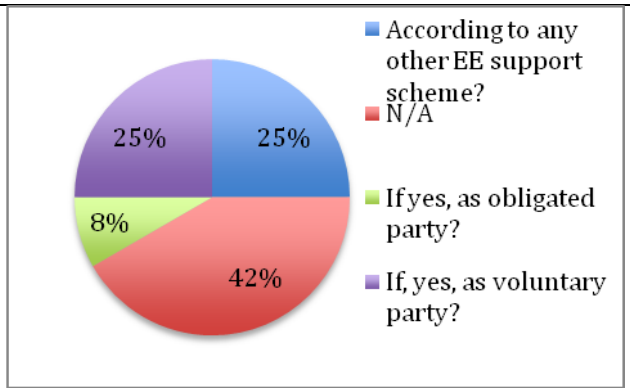


Figure 103: Participation in any Energy Efficiency support scheme (Slovenia)

Furthermore, the **Romanian** industries that contributed for the survey, have participated to Energy Efficiency support schemes, but most of them (58%) are still going to finance their measures by their own capitals in the future (as it had been done also from the majority in the past). However, they show the most interest (27%) for the application of EU projects in comparison to other countries participated in the survey and had given answers that had been analysed. Concerning the financial

instruments, a significant difference can be noticed: most of the participated industries have used tax incentives as a financial instrument in the past, but the vast majority is willing to use subsidies for their future investment in energy efficiency. The choice of tax incentives not only will not be preferred, but also seems to have lost "costumers".

6 Conclusions

6.1 General results: A summary and comparison of the results from the three questionnaires

In general, when comparing and combining the results coming from the three different target-groups (industry, ESCOs and associations) a similar picture is provided regarding the status of energy efficiency in European industry. However, there is a limited value of possible conclusions from the survey because of the relatively little number of responders.

The first section of the survey aims to examine the profile of the participants, (see also introductory chapter). The results of the survey show that most of the participated companies are medium and very large sized companies, which have a good awareness of their energy issues. The majority of companies have energy costs between 2% and 10%in relation to their turnover. The answers given by individual companies show that most of companies believe that their energy costs may be cut by 5-10% after the implementation of energy efficiency measures, which agrees with the answers given by the industry associations.

The results indicating the overall energy consumption (companies: 1000 -10.000TOE/year, ESCOs: 100-1000TOE/year, associations: more than 10.000TOE/year) as well as the electricity consumption (companies: 1000 -10000TOE/year, ESCOs: not available, associations: more than 10.000TOE/year) had been different for each of the three targeted-groups. The consumption of thermal energy as a percentage of electricity consumption was more or less the same for companies and ESCOs (0-25% TH/EL) but totally different for associations (more than 100% TH/EL).

Regarding the self-production of energy, the majority of companies (in total, 52.3%) produce energy either thermal, electrical or both.

The next section of the survey, which focuses more specifically on energy efficiency, shows more comparable results across the three targeted-groups. All three target-groups have clearly declared that the majority of companies have participated in a support scheme and have conducted energy audits. Furthermore, the majority of individual companies have already appointed an energy manager, and most of the associations declared that all of their members have appointed an energy manager as well. However, most ESCOs declared that only around 25% of the companies they serve have appointed an energy manager. This is because the ESCOs provide the required support to the companies they serve. Most ESCOs also declared that none of the companies they serve had been certified to ISO50001, while most of individual companies had been certified. The results related to associations are similar to the results from the ESCOs: associations are either are not sure of their members' status concerning ISO50001 certification or are sure they are not certified.

The vast majority of individual companies and most of the members of associations have recently carried out energy efficiency measures. The main reason for those companies that have not yet implemented measures was economic inconvenience, while the main motivation for the implementation of energy efficiency measures was a reduction in energy costs, which is the same

reason which lead companies to ask for services from ESCOs to investment in energy efficiency. For individual companies, the second most important motivation was a reduction in production costs, while for members from associations it is the improvement of the core business attractiveness through an enhanced sustainability of products/ services and for companies served by ESCOs the main motivation was legal obligation to implement energy efficiency measures. Hence, the reduction of energy costs appears as the main motivation for all target groups, while the second most important reason varies in each category from economic reasons (reduction of production costs) to legal obligation or the benefits of a more sustainable company profile. This variation depends on each company's priorities.

All target groups claim that most energy efficiency measures are applied to the manufacturing process of their products/services. This is probably due to the sectors of the participated companies. For companies served by ESCOs and for individual companies, the use of inverters (VSD systems) was chosen as the most effective intervention, while members of associations had mainly invested in energy combustion systems. After the implementation of the measures, individual companies observed a reduction of up to 5% of their total energy costs, while ESCOs and associations had noticed that the companies they serve and their members saved between 5-10% of their energy costs. The majority of companies were satisfied with the achievements of their energy efficiency measures.

The final section of the survey focused on the economic and managerial feasibility of energy efficiency investments. The vast majority of companies consider the investment cost as a barrier to implementing energy efficiency measures, but only consider it of medium level importance. In all target groups, the majority of companies had used their own capital to finance the investments. Furthermore, subsidies were the most commonly used financial instrument. In terms of barriers to implementing energy efficiency measures, too long payback periods were declared to be the most important barrier for the implementation of energy efficiency measures, followed by bureaucracy. The fact that all three target groups had indicated investment subsidies to be the most important factor for investing in energy efficiency measures, underlines the importance of the initial costs as a barrier and the need for economic and political support as well as a reduction in bureaucratic procedures.

Interesting results occur when participants were asked to evaluate the importance of different barriers. ESCOs had identified the *procedures, time and costs of providing the data for monitoring the consumption of the policy* to be of high importance, while individual companies considered the *procedures, time and costs required to receive the grants* of high importance. This could be explained by the fact that most of the companies served by ESCOs did not have an appointed energy manager in place to enable the provision of necessary data. On the other hand, the fact that most individual companies used their own capital to finance the investments might be explained by the fact that although they are concerned with long payback periods and the initial cost, they would rather avoid the procedures, time and costs required to receive the grant. The industry associations on the other hand, had declared the *procedures, time and cost for researching the most effective technology* to be of high, medium and low importance.

Finally, in order to assess the organisational feasibility for the implementation of energy efficiency investments, individual companies and associations had been asked to evaluate the importance of

different factors for the positive development of energy efficiency measures. The least important factor for all target groups was the social acceptance of the measure. The three most important factors for individual companies were the knowledge of the available solutions, the knowledge of the company's energy consumption and the availability/ability of its engineers. The associations on the other hand declared the knowledge of the available solutions, the regulatory frameworks and the stability of frame conditions (RES targets, incentives etc.) to be of equally high importance. As none of the associations had declared the knowledge of the available solutions to be of low importance (while the other two factors had some votes of low importance), and it was the first priority for individual companies, it can be concluded that the knowledge of available solutions is the most important factor for the majority of participants.

6.2 Conclusions

The answers provided by the three target groups presented both similarities and differences. In general, it can be concluded that although initial investment costs and too long payback periods are considered to be important barriers for the implementation of energy efficiency measures, most companies chose to invest in energy efficiency measures using their own capital, since the level of bureaucracy required to receive grants seems to be a significant barrier. However, subsidies are generally perceived to be a useful financial instrument.

Interventions in the manufacturing processes of companies' products/services aimed at reducing energy cost were generally seen as an effective intervention. Usually interventions resulted in 5 - 10% reductions in energy consumption, which is more or less what had been initially expected by the implementing companies, resulting in general satisfaction with the achievements of the implemented measures.

The current level of energy awareness and management across industries is satisfactory, as the analysis shows that most of the companies have either already appointed energy managers, use energy performance indicators and/or are not certified to ISO5001 or they are turning to ESCOs and associations for further assistance. Information on the trends of energy efficiency measures, in combination with a more general knowledge on their energy status, existing energy regulations and the stability of the frame conditions seems to be crucial for companies to invest in energy efficiency measures in the future.

ANNEX- Questionnaires

Availability of questionnaires

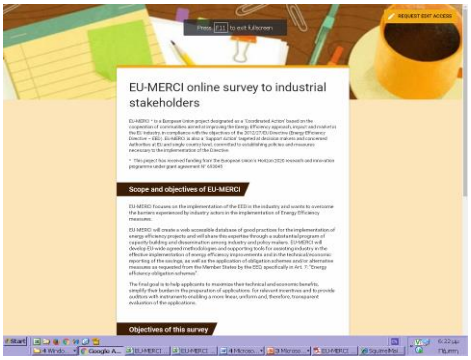
The questionnaires are available in Word Document and in the web Google Forms.

A stakeholder can work in English by:

a) Filling in the questionnaire as it is, online.

- A-COMPANIES:

  https://docs.google.com/forms/d/1XAxdETfrJoxHzlGSLLtJzw4BknKFXwCtR_PVj458SwQ/viewform



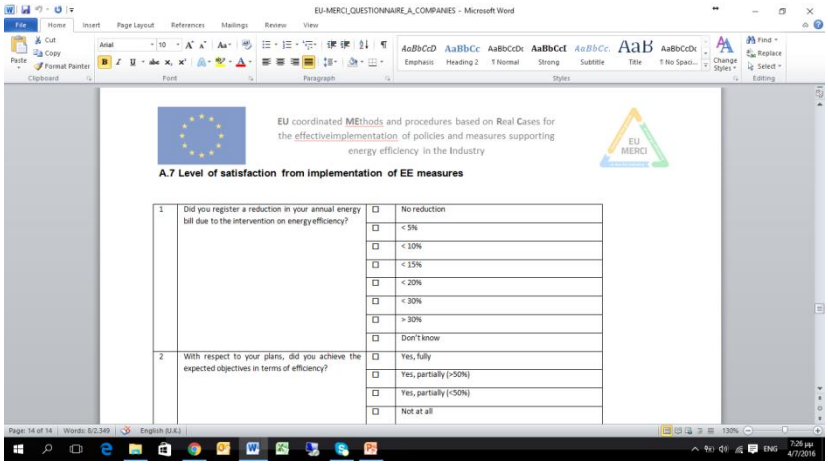
- B-ASSOCIATIONS:

https://docs.google.com/forms/d/1SexG0IH-1ifccoCEJYvBfYCDFg_ssPcEidtRVzWGdpM/viewform

- C-ESCOS:

https://docs.google.com/forms/d/1mby99Bt0b5feafmlTkwaJewBv_dFKObNlJdVOWGKzvA/viewform

b) Filling in the questionnaire, in the word document.



The questionnaires have been translated into Bulgarian, German, Greek, Italian, Romanian, Portuguese, Spanish and Turkish

Recipients

The partners selected from the stakeholders list where to send it, according to the 3 categories of the questionnaire. The associations distributed to its members directly. The EU federations and associations have been also contacted.

Timeline

The campaign started in July 2016 and, officially ended in November 2016. Nevertheless the questionnaires are available online.