Report on identified barriers

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WP leader: **Environment Park**
Author: **Galeasso Luca, Environment Park**

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Contents

1 Objectives and methodology

This report has the main objective of exploring the categories of barriers for the implementation of energy efficiency by industry, to build a robust frame and collect inputs for the implementation of the IMPAWATT platform contents (task 1.3).

The document is the result of several different activities, implemented with an integrated approach by the IMPAWATT project partners:

- A review of existing literature and reports on barriers for implementation of energy efficiency in industry
- A survey on a selected group of companies and SMEs
- A set of direct interviews to a group of significant stakeholders (partly belonging to the IMPAWATT Energy Advisory Board), representing large groups of operators and having a strong experience on energy efficiency in industrial and service sectors

The literature review was developed in collaboration between the project partners; each of them contributed to identify some relevant studies and reports which allowed the identification of the state of art in the sector, to better specify the contents of the questionnaire and select the specific barriers to investigate through the survey.

The survey on barriers was conducted through a specific on line questionnaire, whose concept was aimed to collect the opinion and perception of obstacles that industries (and in particular SMEs) meet day by day in the implementation of their energy efficiency measures, identified through mandatory or voluntary energy efficiency auditing activities or under the push of other factors.

The analysis was focused not only on implementation related aspects, but also on the issues related to the planning step of implementation process.

The questionnaire (see annex I) ,developed through the use of Google Forms platform, was articulated in the following sections:

- Company profile
- Approach to energy management
- Analysis of the energy efficiency measures planned/implemented by the organizations
- Evaluation of barriers in implementation of energy efficiency measures
- Analysis of the drivers in implementation of energy efficiency measures
- Analysis of the barriers in planning energy efficiency measures
- Personal information and contacts

A target of 10 enterprises was identified for each project partner, giving priority to the SMEs with more than 20 employees, identified in the application step, that confirmed their interest and motivation to participate in the project. The campaign started in July 2018 and ended in August 2018. A total of 65 questionnaires were collected, on a group of 85 enterprises contacted.

Finally, 3 interviews with qualified stakeholders and experts in the sector of energy efficiency (representatives of associations, energy managers, energy experts and policy makers) [1]allowed to confirm and integrate the survey results, with a qualitative contribution complementing the more quantitative analysis conducted through the elaboration of the questionnaires.

[1] - Richard Phillips, Head of Market Unit for Electric Drive Systems, Swiss Federal Office of Energy (SFOE)
- Petra Lackner, Austrian Energy Agency, programme-management klimaaktiv energy efficienc companies
- Michele Santovito, President of Italian Association of Experts in Energy Management (ASSOEGE) and member of the directive board of Italian Federation for Rational use of Energy (FIRE)

2 Barriers for implementation of energy efficiency measures – Identification of the main categories

Different categories and sub-categories of barriers for the implementation of energy efficiency measures can be identified; some of them can be associated to all type of measures while others are more specifically related to one or more measures or are sector-specific.

Potentially, several classifications (taxonomy) are available and several existing studies on energy efficiency barriers refer to different types of categories.[2]

Considering the aims of IMPAWATT project, three main categories of barriers can be identified, classified on their origin and type:

- Economic barriers of internal origin
    - Hidden costs (need for additional resources, training or equipment)
    - Additional risks associated to the implementation of energy efficiency measures
    - Restricted financial and economical capacity
- Non economic "internal" barriers, basically related to organizational and behavioural aspects
    - Low sensitivity and awareness levels
    - Lack of competences and skills at staff level
    - Energy is not included in the core business
    - Staff attitude and behaviour
    - Lack of information and imperfect evaluation criteria
- "external" barriers, mainly related to the supply chain, the capital suppliers and the market readiness in terms of innovation and available technology providers
    - The supply chain is not developed or the production has still not adequately reached the market (non-industrialized production)
    - Solutions are complex and hard to be integrated in the context of the organization
    - Legislative and regulatory constraints
    - Costs and difficulties to access incentives
    - Residual uncertainty of the credit system and capital suppliers in the process of assessing the bankability of investments

[2] « Study on Energy Efficiency and Energy Saving Potential in Industry and on Possible Policy Mechanism », IFC International, December 2015

3 Mapping of barriers for industrial sector

3.1 Company profile

The survey campaign resulted in 65 compiled questionnaires from companies located in the 6 different countries represented in IMPAWATT project.

The sample can be considered representative in terms of geographical coverage and dimension of enterprises.

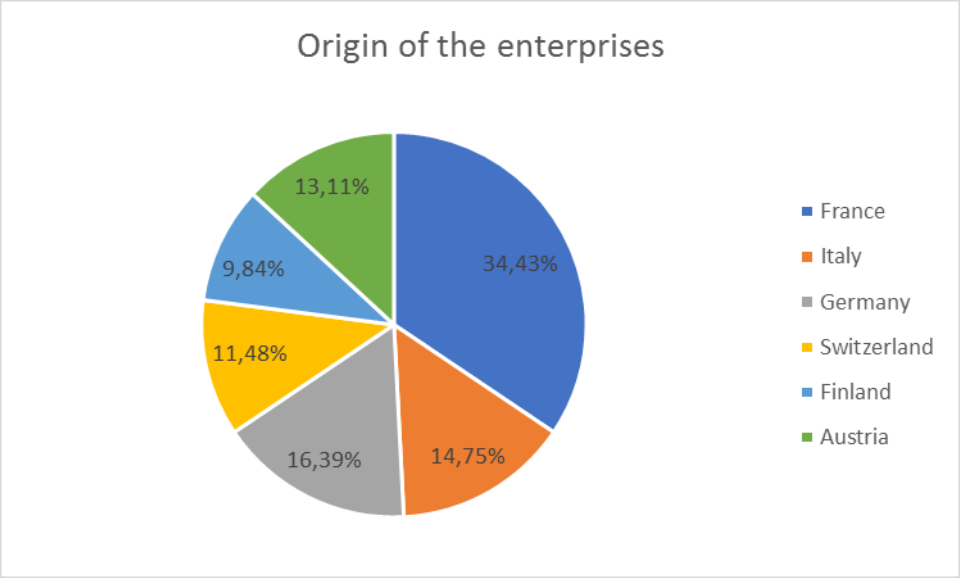


Figure 1 – Country of origin of enterprises answering the survey

The sample also provides a good representation of several activities and economic sectors, according to the european NACE classification.

The following graph represents the number of responses received for each sector (NACE groups), and the next table groups the 59 enterprises that declared their activity on the basis of the NACE division

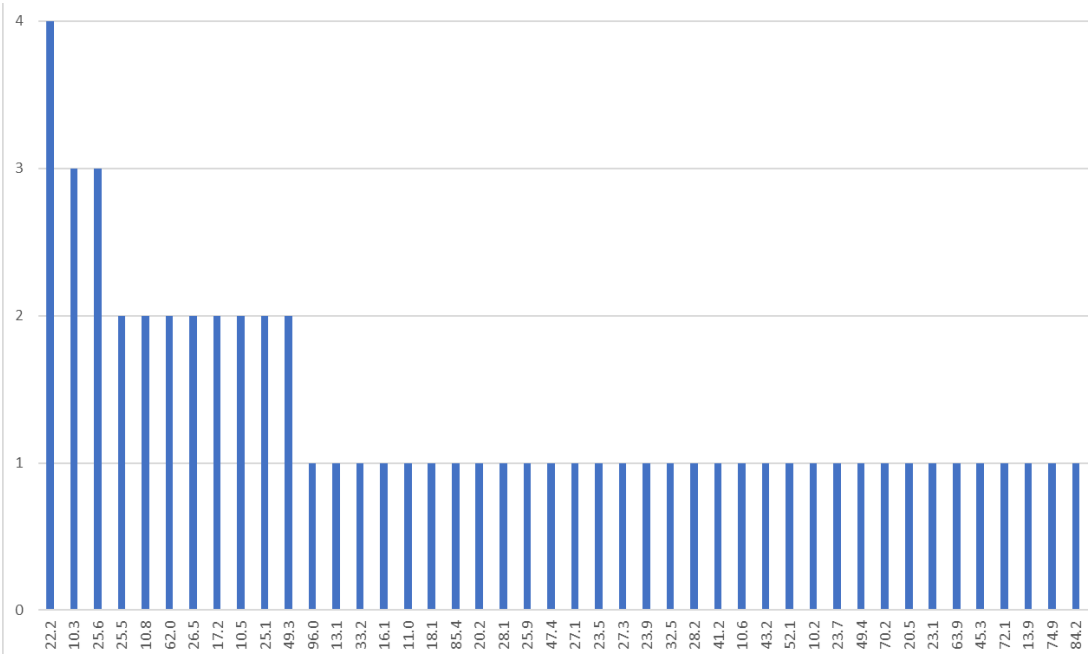


Figure 2 – Number of responses by NACE group

NACE code (division)	Description	Number of responses
10	Manufacture of food products	9
25	Manufacture of fabricated metal products	8
22	Manufacture of rubber and plastics products	4
23	Manufactute of other non metallic mineral products	4
49	Land transport	3
13	Manufacture of textiles	2
17	Manufacture of paper and paper products	2
20	Manufacture of chemicals	2
26	Manufacture of computer, electronic and optical products	2
27	Manufacture of electrical equipment	2
28	Manufacture of machinery equipment	2
62	Computer programming and consultancy	2
11	Manufacture of beverages	1
16	Manufacture of wood and products of wood	1
18	Printing and reproduction of recorded media	1
32	Other manufacturing	1
33	Repair and installation of machinery equipment	1
41	Construction of buildings	1
43	Specialised construction activities	1
45	Trade and repair of motor vehicles	1
47	Retail trade	1
52	Warehousing	1
63	Information serivce activities	1

NACE code (division)	Description	Number of responses
70	Activities of head offices, management consultancy activities	1
72	Scientific research and development	1
74	Other professional, scientific and technical activities	1
84	Services to the community	1
85	Education	1
96	Other personal service activities	1

Number of responses by NACE code (divisions)

The manufacture of **fabricated metal products** (NACE 25), **rubber and plastics** products (NACE 22) and **food products** (NACE 10) are the most represented. Inside NACE 10, more than one organization is active in processing and preserving fruit and vegetables (group 10.3), dairy products (10.5) and other food products (10.8). In NACE 22 and 25 divisions, most companies are specifically dealing with manufacturing of plastics products (22.2), treatment and coating of metals (25.6), pressing and stamping of metal (25.5) and manufacture of structural metal products (25.1). In the other NACE divisions, also passenger land transport activity (49.3) and computer programming (62.0) are represented by more than one organization.

About 60% of organizations have a size between 10 and 249 employees, with the rest of enterprises splitted between those having less than 10 employees or more than 249.

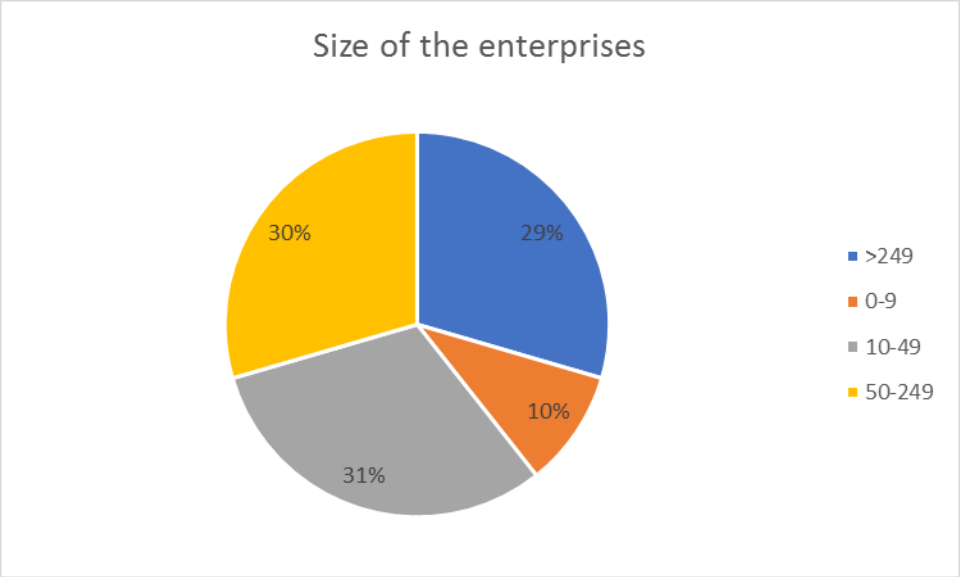


Figure 3 – Number of employees

More than half of the enterprises have a % ratio between energy costs and annual turnover between 1 and 5%, showing a quite low energy cost incidence of the interviewed organizations. 18% of the enterprises don't know the amount of the indicator.

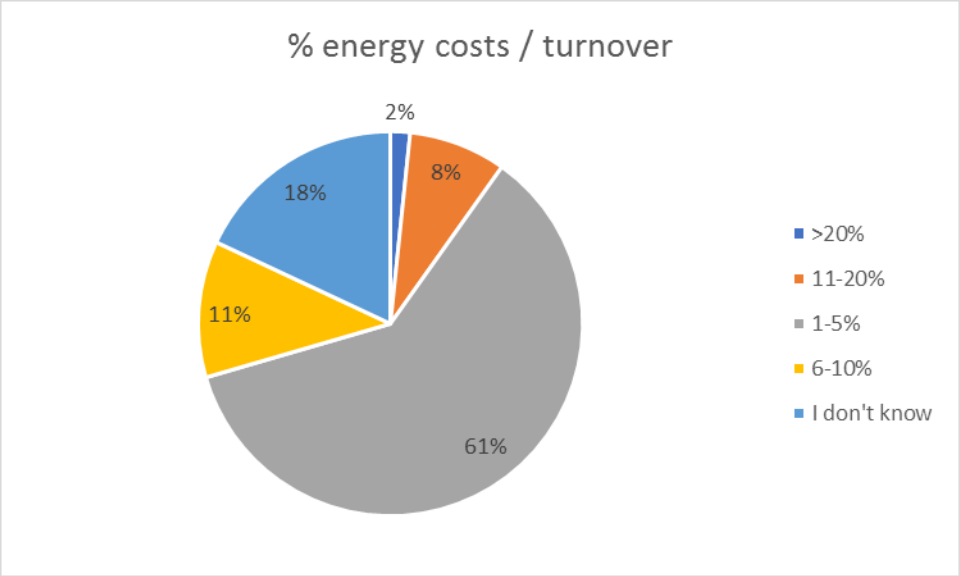


Figure 4 – Incidence of energy costs

3.2 Approach to energy management

This section of the report describes the strategies that participating enterprises apply inregard to energy efficiency, focusing on their pro-activity level in management and measurement energy uses and energy consumption. This information is particularly relevant to identify the preliminary level of sensitivity with respect to the topic of energy efficiency, that can influence the process of energy efficiency and the overcome of the existing barriers.

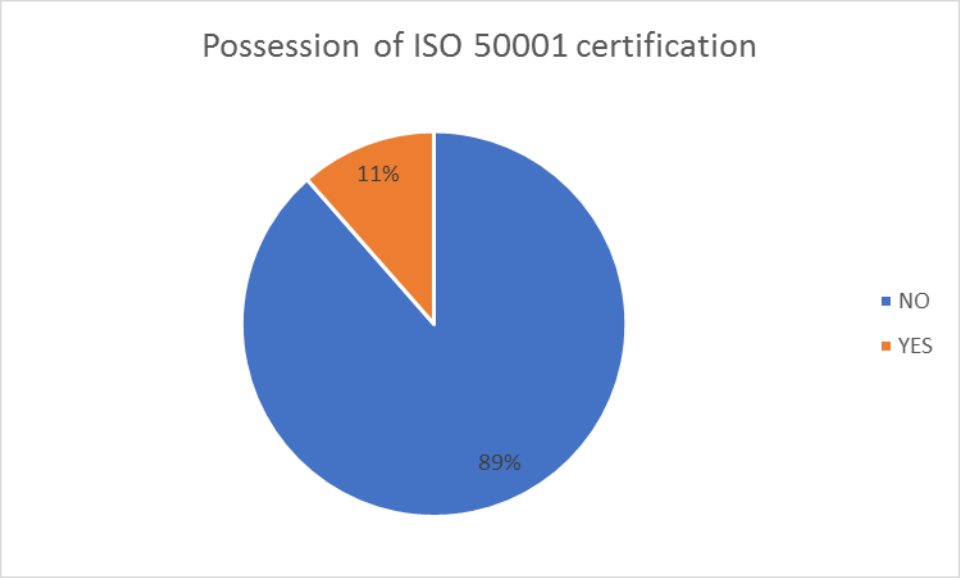


Figure 5 – Adoption of ISO 50001 standard

The implementation of an energy management system according to ISO 50001 standard is not considered by the enterprises as a priority (only about 11% have adopted it) and a powerful tool in the systemic approach to improve in energy efficiency. This result is quite coherent with the dimension of the answering participants. Although this aspect, **71% of them conducted an energy audit**, more than half of them for mandatory reasons according to the European and national schemes for energy efficiency in industrial and service sectors. The existence of an energy audit represents a good entry point to establish processes of implementation of energy efficiency measures from the identification of Energy Saving Opportunities (ESOs).

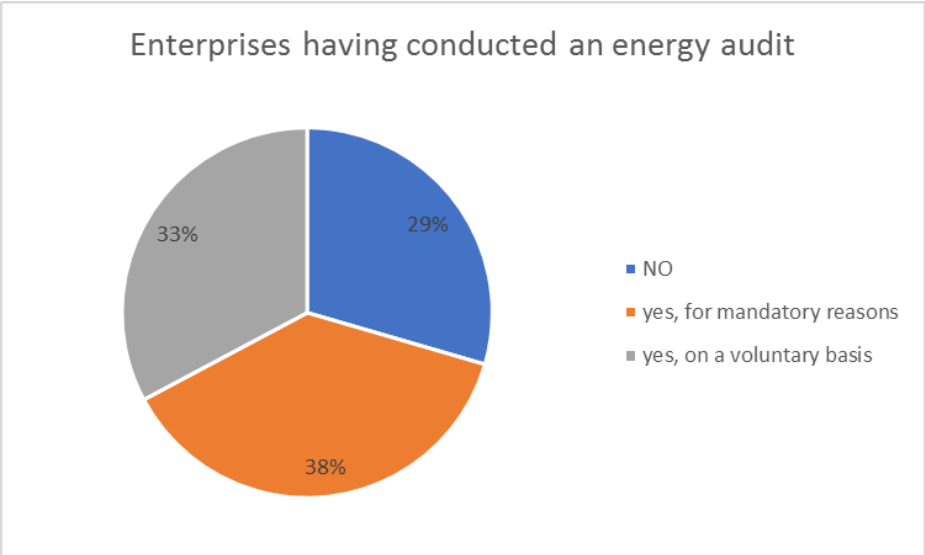


Figure 6 - % of enterprises having conducted an energy audit

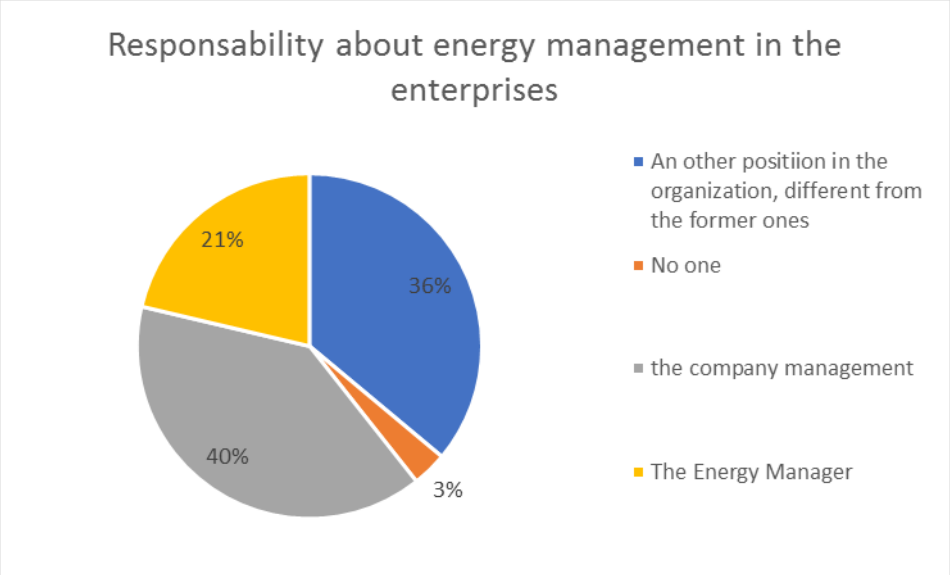


Figure 7 – Responsabilities and roles for energy management

Only 3% of the interviewed companies have identified andentitled an energy manager; in 40% of enterprises the energy management aspects are in charge to another position (QSE manager or Facility manager for the most of them).

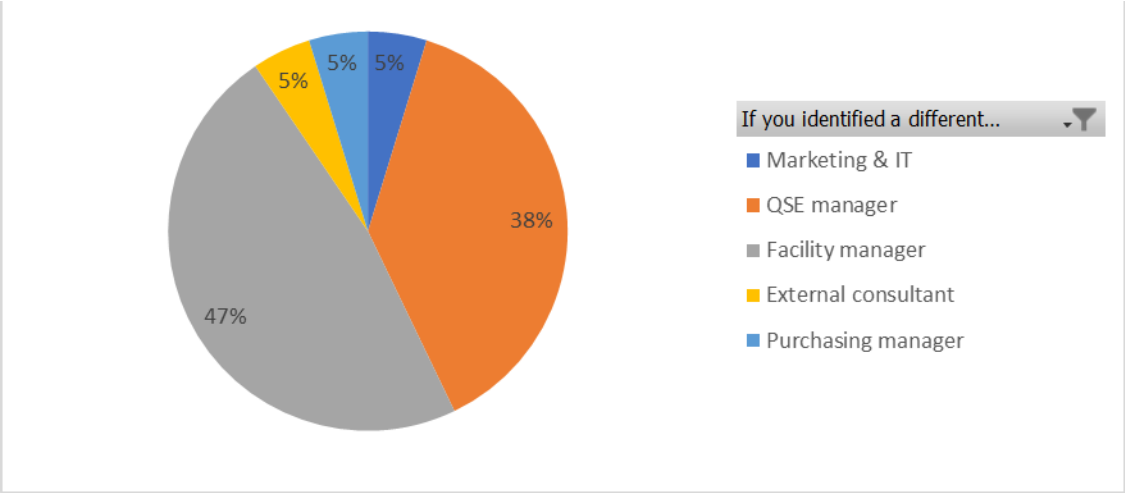


Figure 8 – Positions in charge of energy management (when different from company management and Energy manager)

The use of energy indicators to describe the performance of the organization is not a common practice (almost half of the sample doesn't make use of indicators). For those enterprises using indicators, the level of production is the most used reference parameter, followed by the measurement of the only absolute consumption. Very few companies make use of energy monitoring of their single processes, and only one considers the energy consumption of single users and appliances.

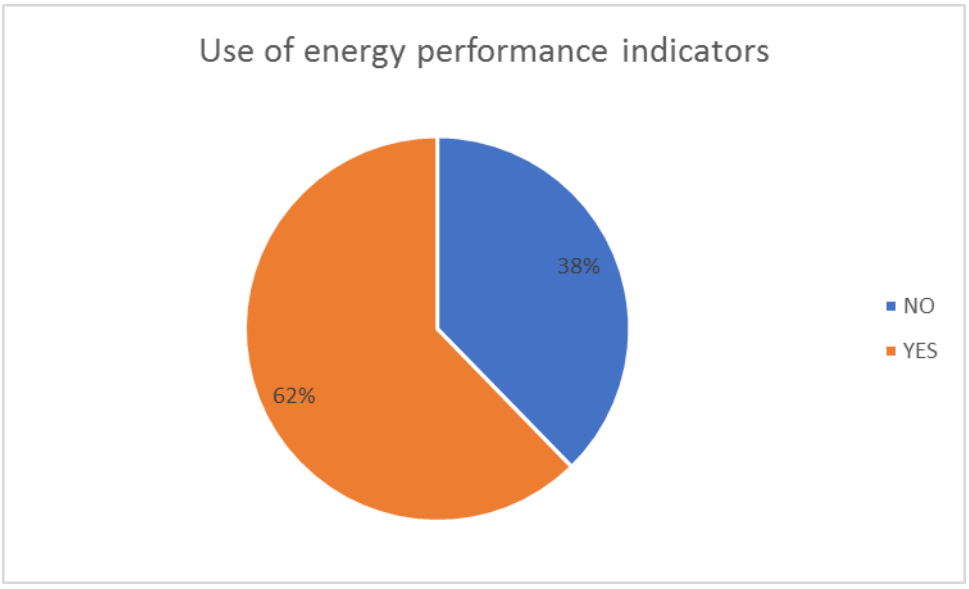


Figure 9 – Use of energy performance indicators by respondents

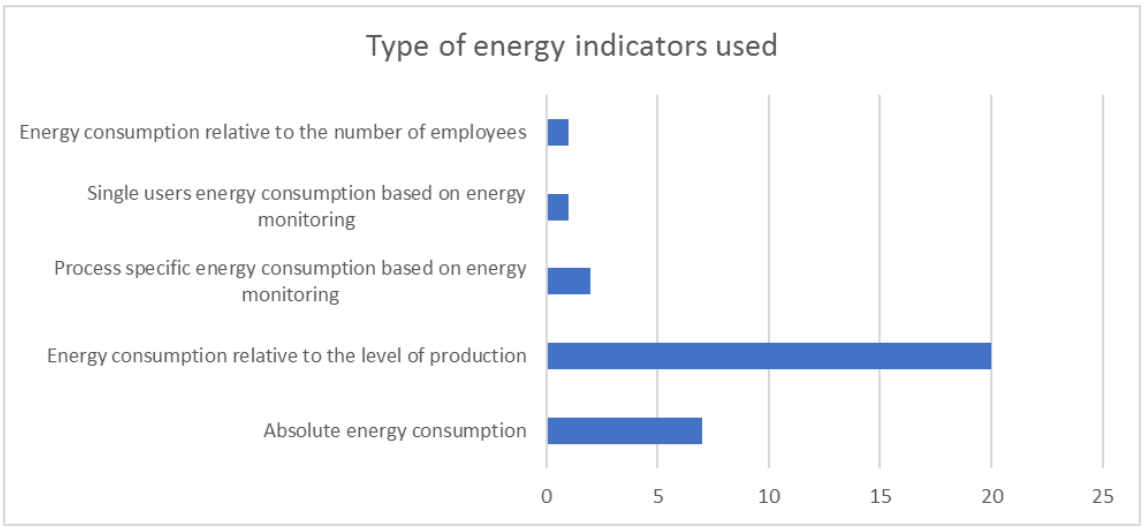


Figure 10 – Types of energy indicators used

Life Cycle Thinking approach is used by almost the half of the interviewed organizations, both for the improvement of the performance of their products and processes and in the procurement of their materials and equipment (supply chain oriented approach).

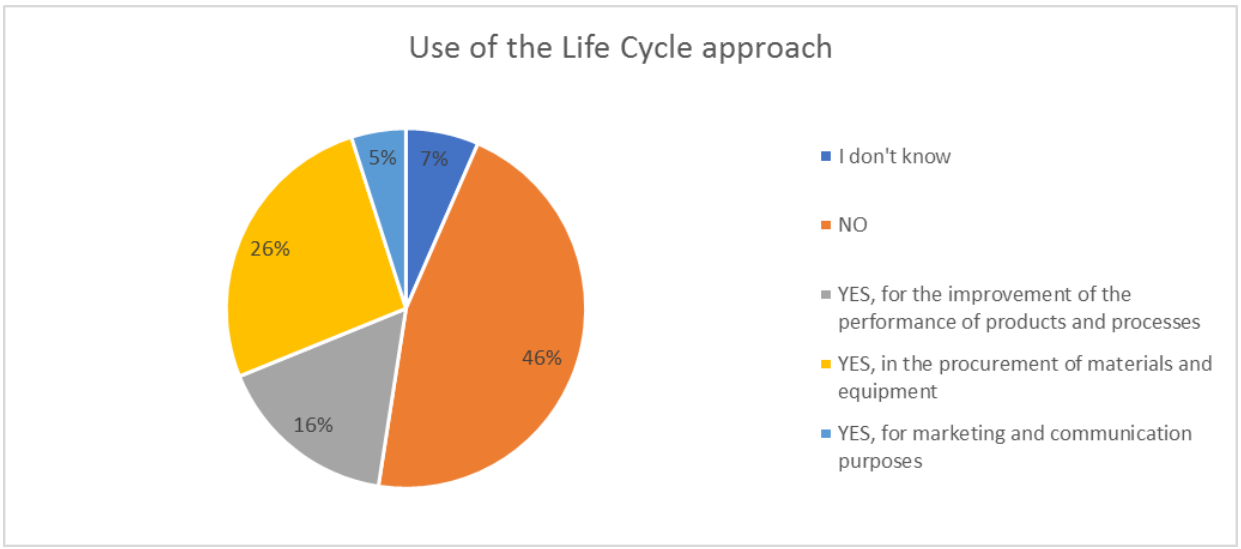


Figure 11 – Use of the life cycle approach by interviewed organizations

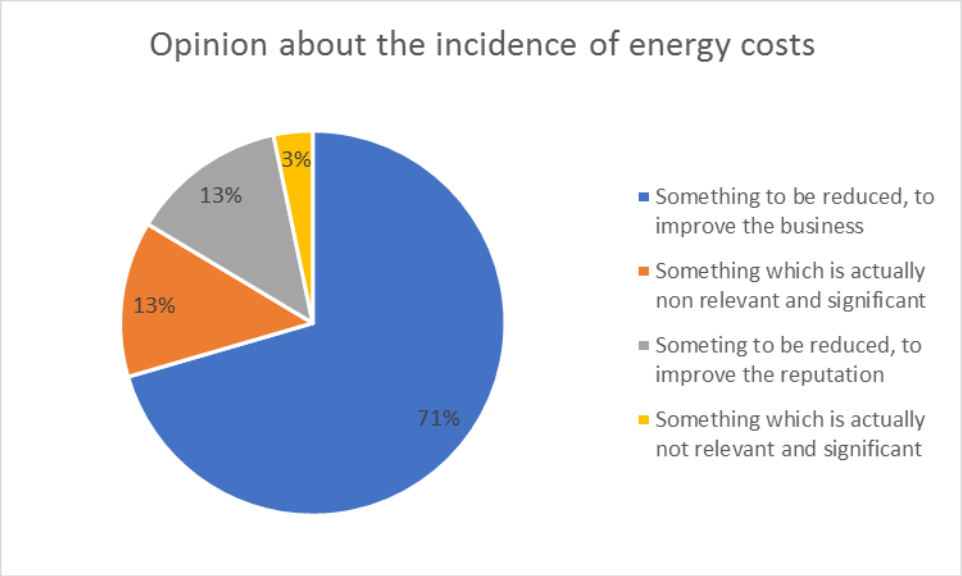


Figure 12 – Incidence of energy costs in the opinion of respondents

Almost 75% of the companies consider the energy cost strictly linked to the improvement of the business and competitiveness of the organization, only about 3% think it is actually not relevant for the business. 13% of the enterprises consider the improvement of the reputation as a prior factor to justify the implementation of energy efficiency measures.

3.3 Energy efficiency measures

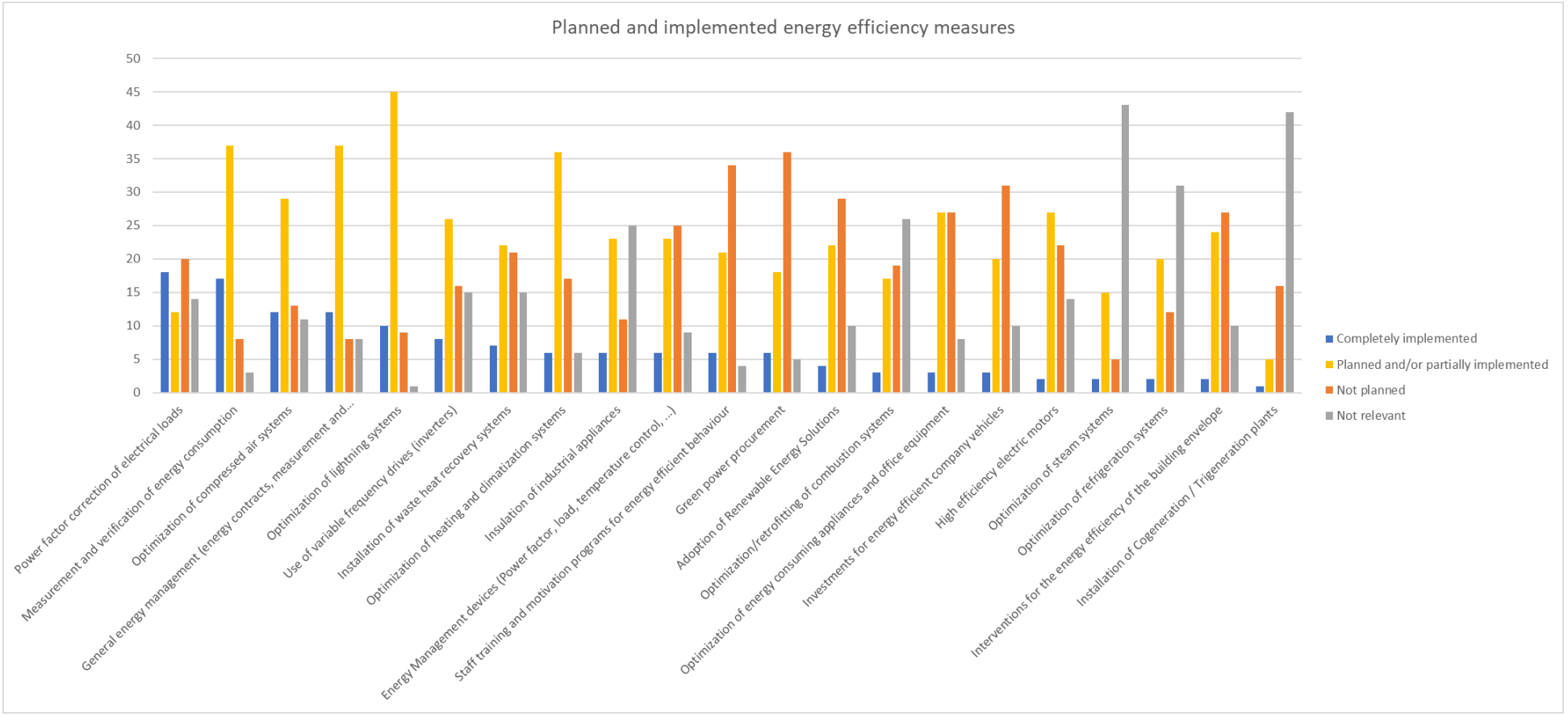


Figure 13 – Level of planning and implementation of energy efficiency measures

The figure above shows the answers about the measures for energy efficiency adopted by the answering organizations. Both planning and implementation steps were explored, so to get a feedback about the different kind obstacles in the process leading from the identification to the complete implementation of the single measures.

The implementation level is quite low for the major part of the energy saving options listed in the questionnaire. The biggest interest (for number of companies having completely implemented the measure) is for "soft" measures: power factor correction of electrical loads, measurement and verification of energy consumption, general energy management and optimization of lightning systems.

Considering the total of the identified energy efficiency measures, most of the companies have planned or partially implemented one or more measures, but very few have completely implemented energy efficiency measures. "Soft" measures like power factor correction of electrical loads, or measurement and verification of energy consumption procedures, have been implemented by about 30% of the organizations, while all other measures have been implemented by no more than 20% of responders.

Partially completed or planned is the most frequent answer for optimization of lightning systems, heating and climatization systems, compressed air systems, energy management (energy contracts) and energy management and verification activities.

Cogeneration/trigeneration (8%) and steam systems (25%) are the less planned measures for the major part of the organizations investigated through the survey, followed by combustion systems (33%), refrigeration (33%), energy efficient vehicles (38%) and green power procurement (39%).

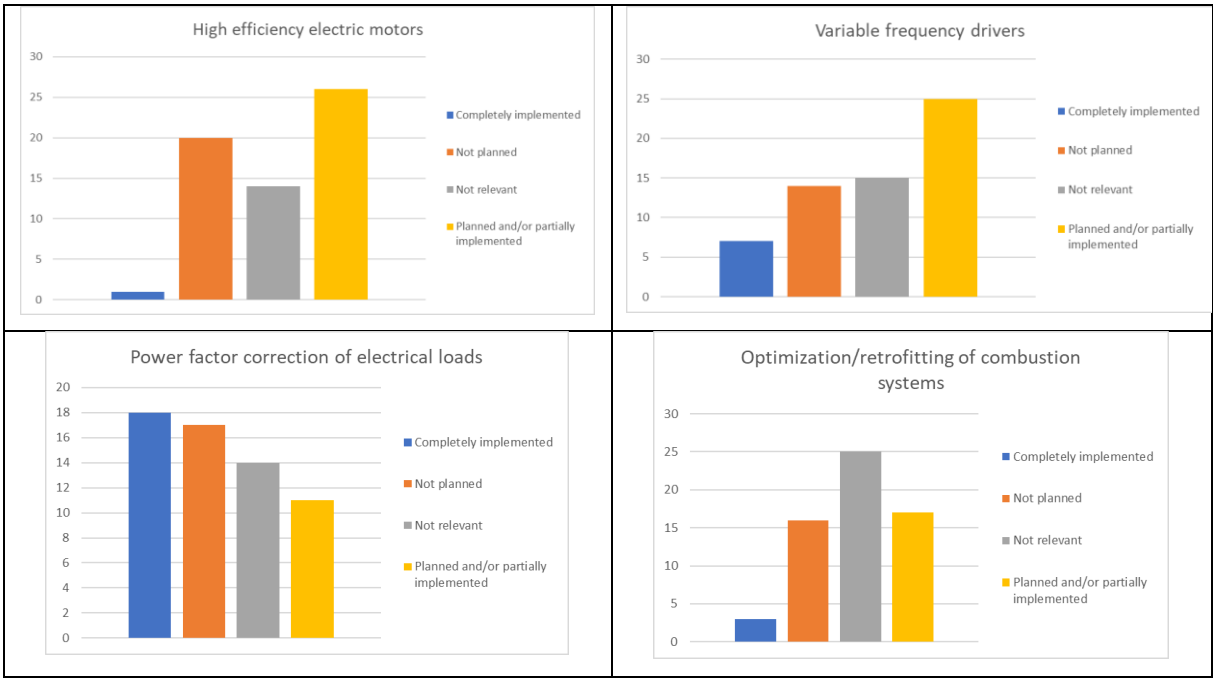
Energy efficiency measure	Level of planning and/or partially implementation
High efficiency electric motors	
Use of variable frequency drives (inverters)	
Power factor correction of electrical loads	
Optimization/retrofitting of combustion systems	
Optimization of energy consuming appliances and office equipment	
Optimization of lightning systems	
Optimization of steam systems	
Optimization of refrigeration systems	
Optimization of heating and climatization systems	
Optimization of compressed air systems	
Installation of waste heat recovery systems	
Insulation of industrial appliances	
Installation of Cogeneration / Trigeneration plants	
Energy Management devices (Power factor, load, temperature control, ...)	
Measurement and verification of energy consumption	

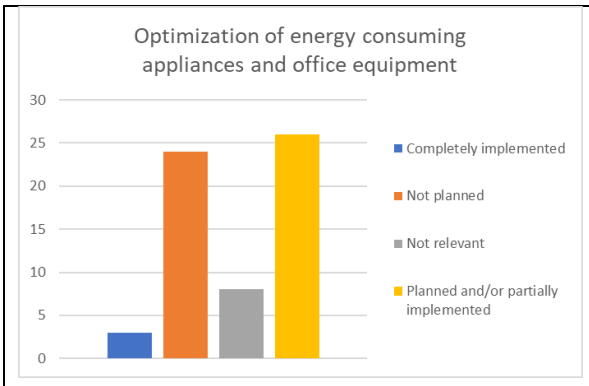
Energy efficiency measure	Level of planning and/or partially implementation
General energy management (energy contracts, measurement and verification actions, ...)	
Interventions for the energy efficiency of the building envelope	
Adoption of Renewable Energy Solutions	
Staff training and motivation programs for energy efficient behaviour	
Green power procurement	
Investments for energy efficient company vehicles	

Figure 14 – Level of planning and implementation of energy efficiency measures

- Measure NOT PLANNED or NOT RELEVANT for less than 40% of enterprises
- Measure NOT PLANNED or NOT RELEVANT for 40 – 60% of enterprises
- Measure NOT PLANNED or NOT RELEVANT for more than 60% of enterprises

The following table describes more in detail the result of the survey for each of the energy efficiency measures.




Optimization of energy consuming appliances and office equipment
30
25
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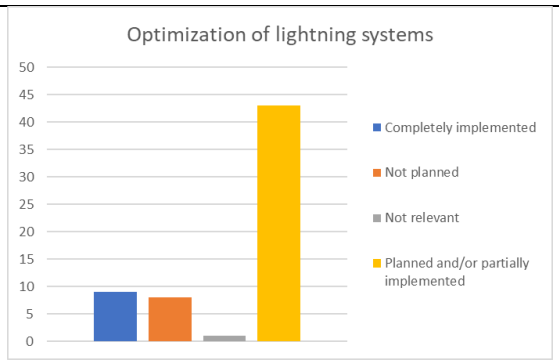
Completely implemented
Not planned
Not relevant
Planned and/or partially implemented


Optimization of lightning systems
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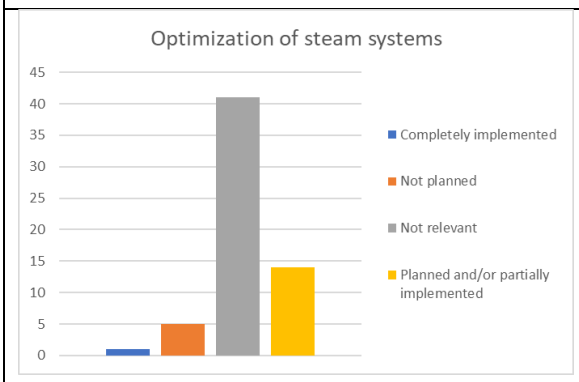
Completely implemented
Not planned
Not relevant
Planned and/or partially implemented


Optimization of steam systems
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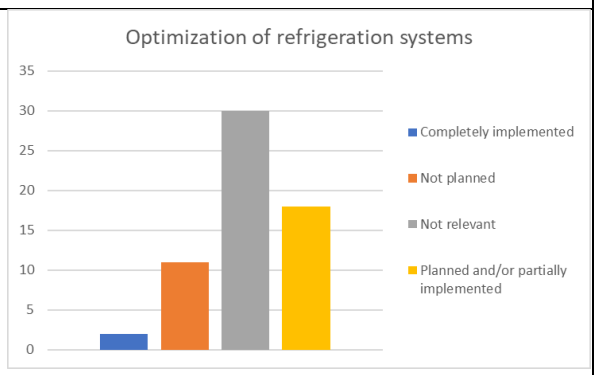
Completely implemented
Not planned
Not relevant
Planned and/or partially implemented


Optimization of refrigeration systems
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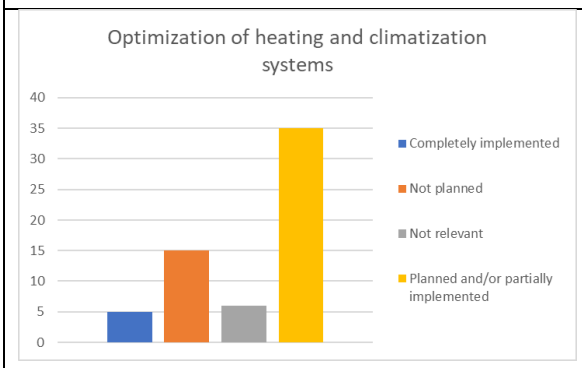
Completely implemented
Not planned
Not relevant
Planned and/or partially implemented


Optimization of heating and climatization systems
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Completely implemented
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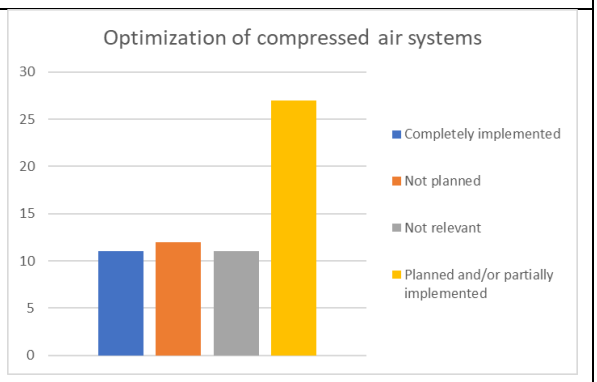
Not relevant
Planned and/or partially implemented


Optimization of compressed air systems
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Completely implemented
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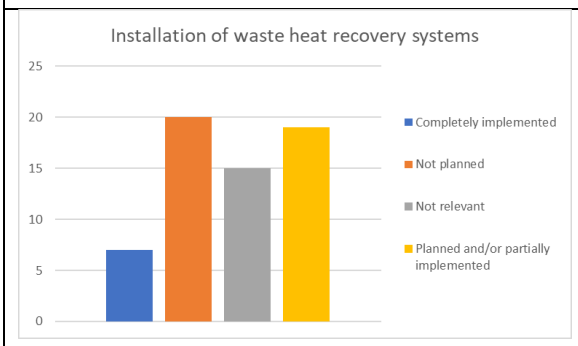
Not relevant
Planned and/or partially implemented


Installation of waste heat recovery systems
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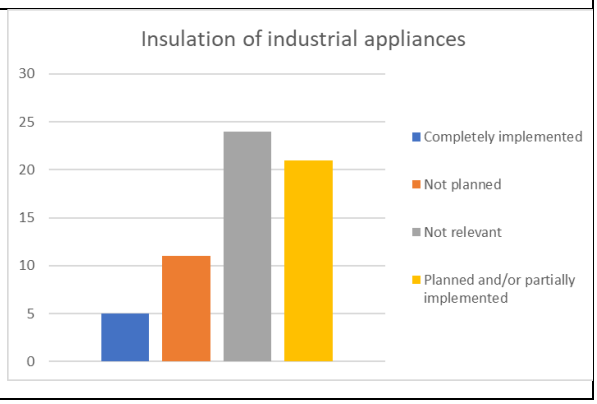
Completely implemented
Not planned
Not relevant
Planned and/or partially implemented


Insulation of industrial appliances
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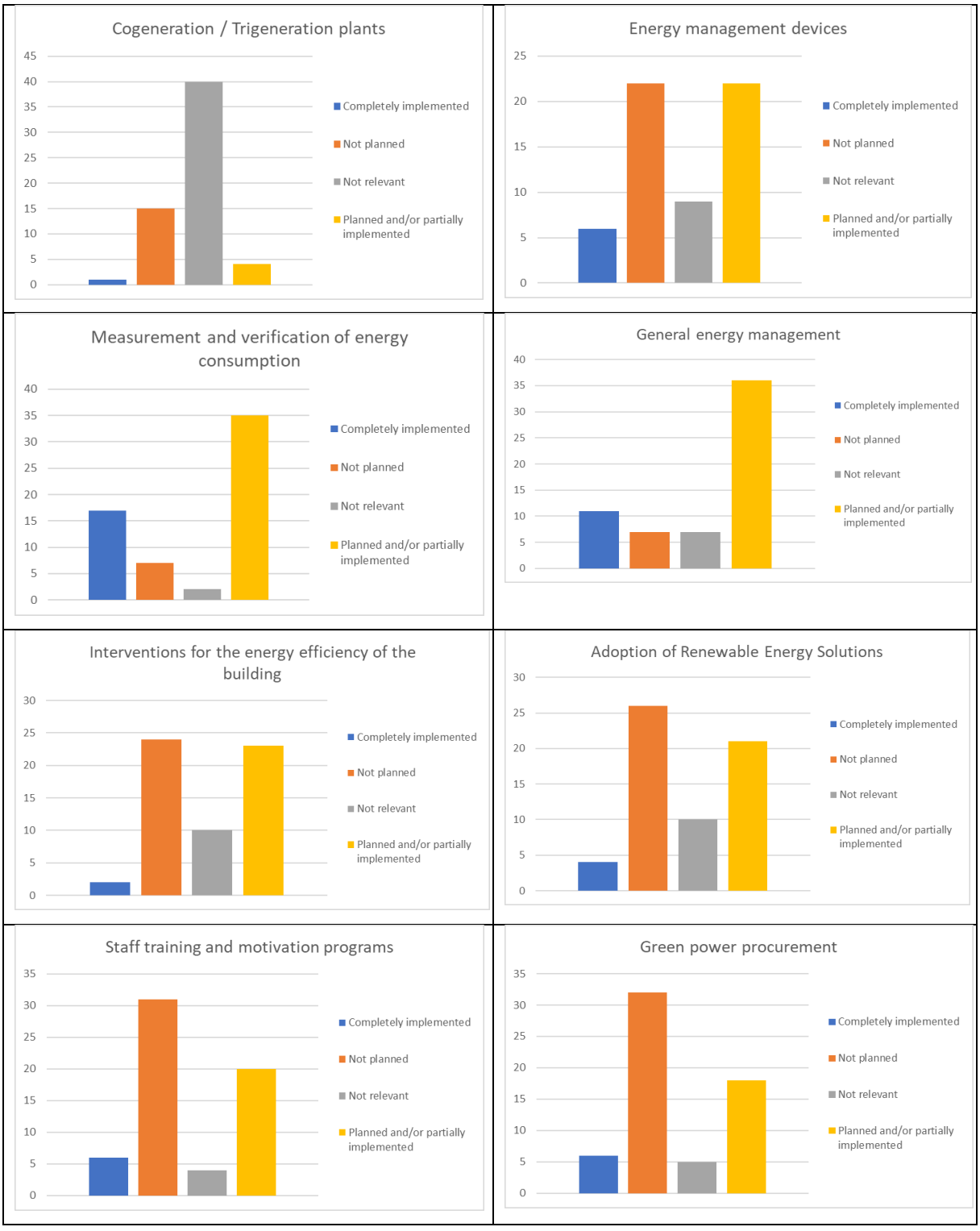
Completely implemented
Not planned
Not relevant
Planned and/or partially implemented


Cogeneration / Trigeneration plants
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Completely implemented
Not planned
Not relevant
Planned and/or partially implemented
Energy management devices
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Completely implemented
Not planned
Not relevant
Planned and/or partially implemented
Measurement and verification of energy consumption
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35
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Completely implemented
Not planned
Not relevant
Planned and/or partially implemented
General energy management
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Completely implemented
Not planned
Not relevant
Planned and/or partially implemented
Interventions for the energy efficiency of the building
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Completely implemented
Not planned
Not relevant
Planned and/or partially implemented
Adoption of Renewable Energy Solutions
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Completely implemented
Not planned
Not relevant
Planned and/or partially implemented
Staff training and motivation programs
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25
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10
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Completely implemented
Not planned
Not relevant
Planned and/or partially implemented
Green power procurement
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Completely implemented
Not planned
Not relevant
Planned and/or partially implemented

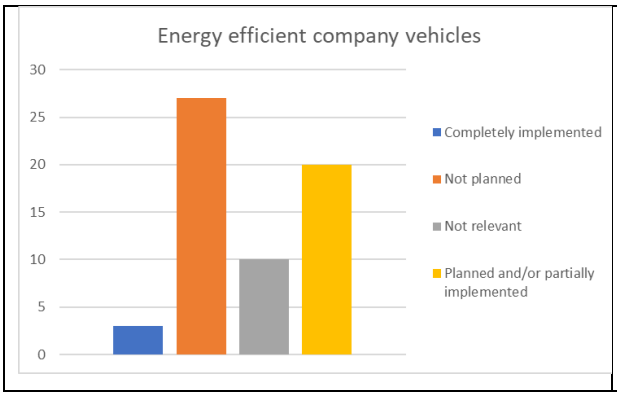


Figure 15 – Planning and implementation level – Focus and comparison of the specific energy efficiency measures

3.4 Barriers in implementation of measures

Economic internal barriers seem to be the most relevant in the implementation process of energy efficiency measures for the interviewed enterprises.

The lack of personnel, the lack of incentives and the uncertainty about the real performance achievements in terms of energy saving (conditioning the pay back time) are very important/important barriers for the 75-80% of the organizations.

Also the difficulties (procedures, time and cost) for providing data necessary for monitoring the measure are considered a significant barriers, with the 52% of answers considering it as important and the 23% as very important.

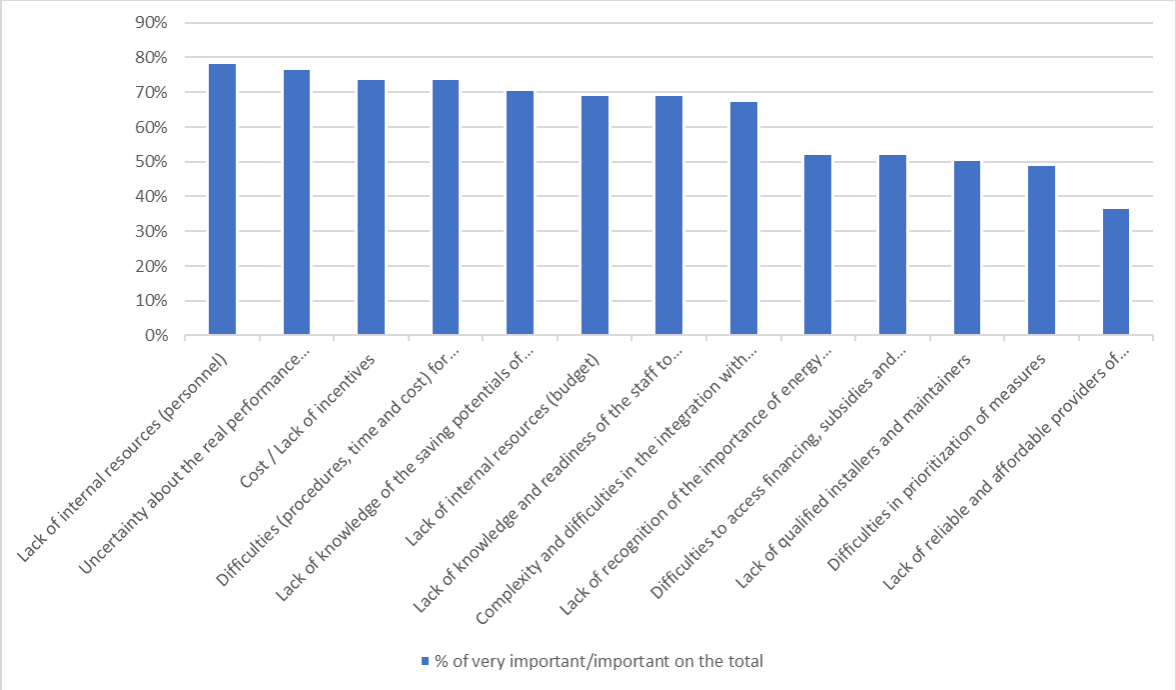


Figure 16 – Level importance of the identified barriers for the respondent enterprises

The integration with the context of the organization seems to be a significant barrier, with the 68% of enterprises considering important the difficulties to integrate the measure with the production processes and with the actual staff organization which should support the implementation. This confirms the fact that point in time for energy efficient interventions is a key issue.

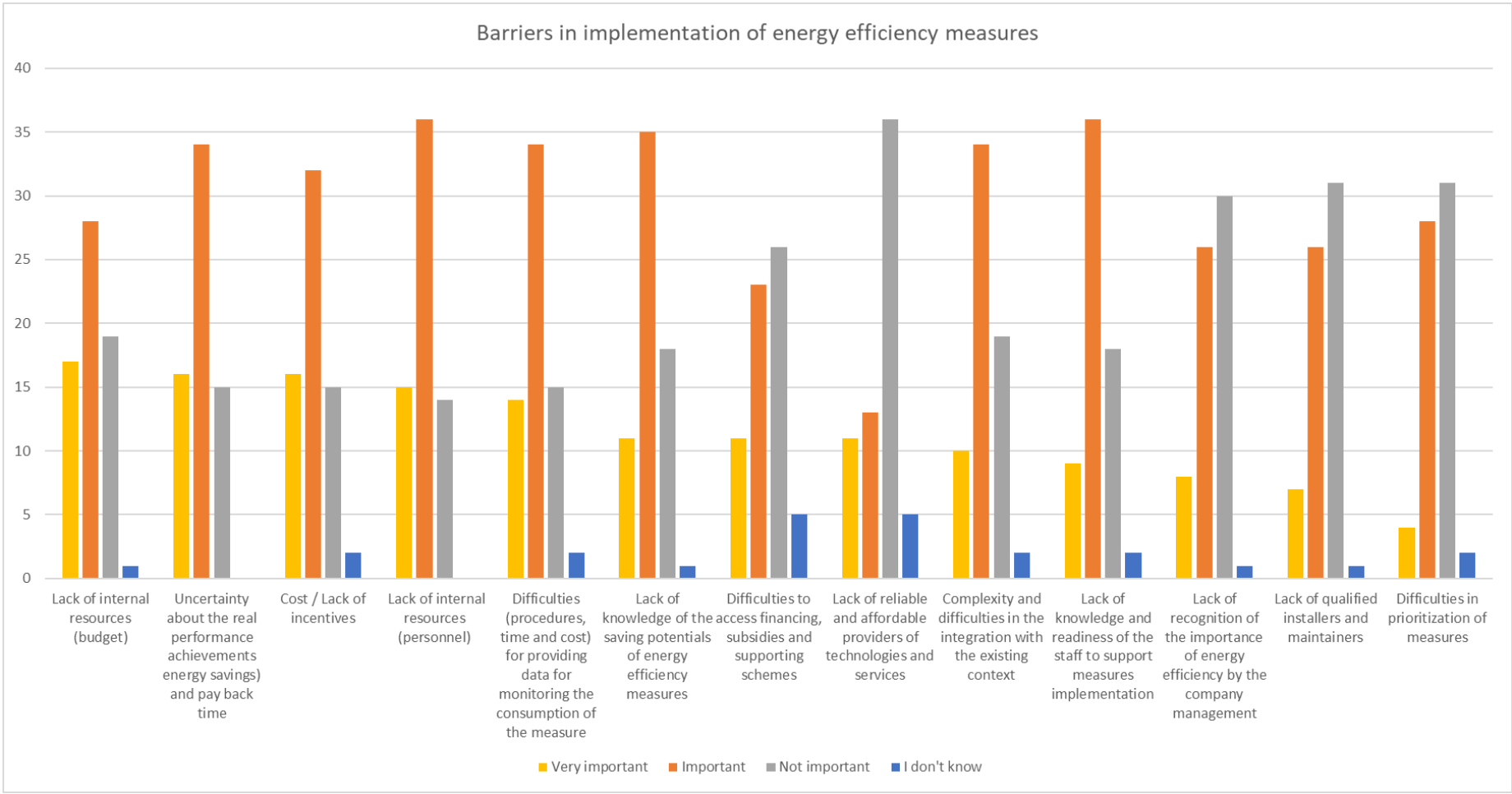
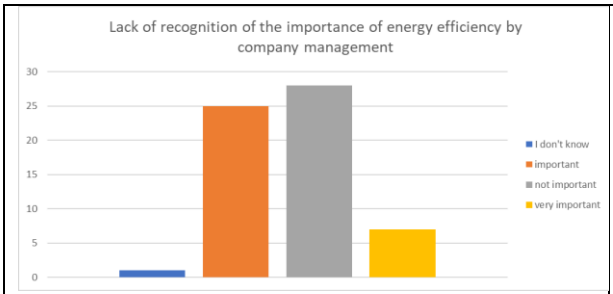
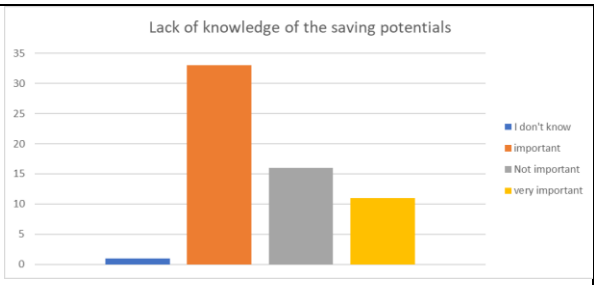
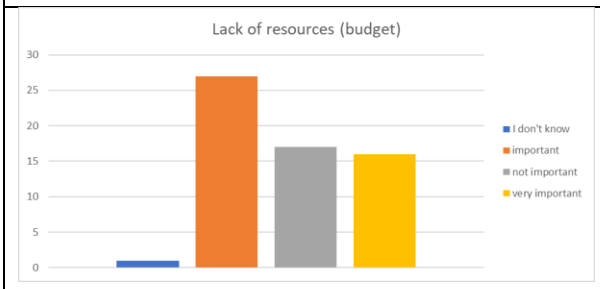
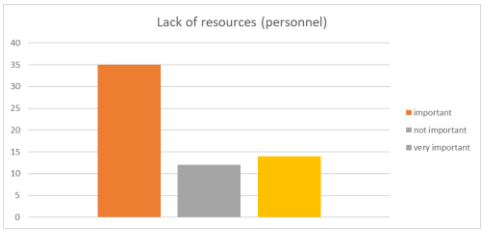


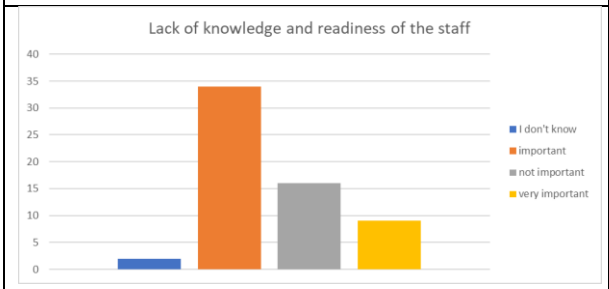
Figure 17 – Barriers in the implementation of energy efficiency measures

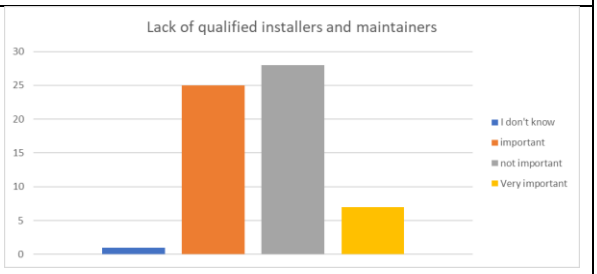

Lack of recognition of the importance of energy efficiency by company management
30
25
20
15
10
5
0
I don't know
important
not important
very important

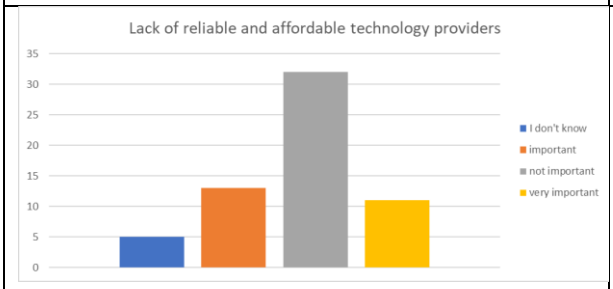

Lack of knowledge of the saving potentials
35
30
25
20
15
10
5
0
I don't know
important
Not important
very important

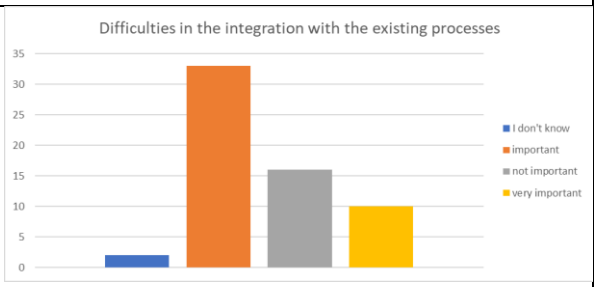

Lack of resources (budget)
30
25
20
15
10
5
0
I don't know
important
not important
very important

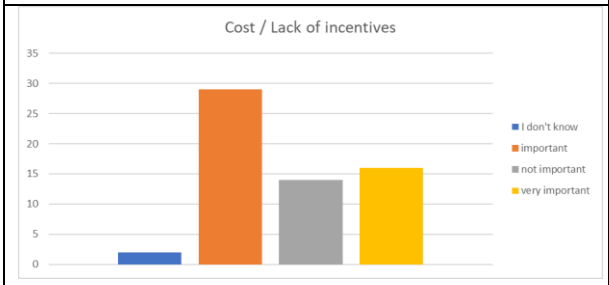

Lack of resources (personnel)
40
35
30
25
20
15
10
5
0
important
not important
very important

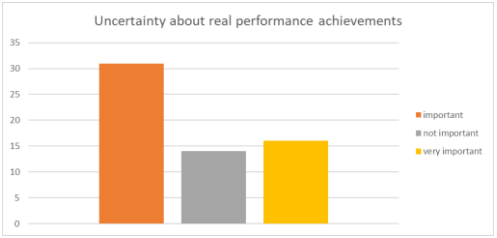

Lack of knowledge and readiness of the staff
40
35
30
25
20
15
10
5
0
I don't know
important
not important
very important

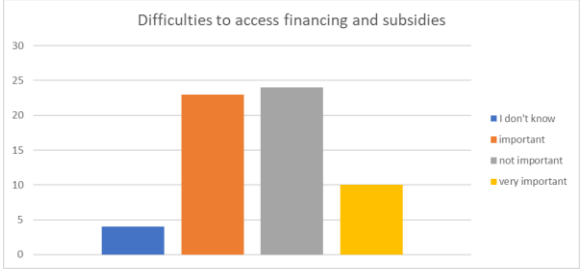

Lack of qualified installers and maintainers
30
25
20
15
10
5
0
I don't know
important
not important
Very important

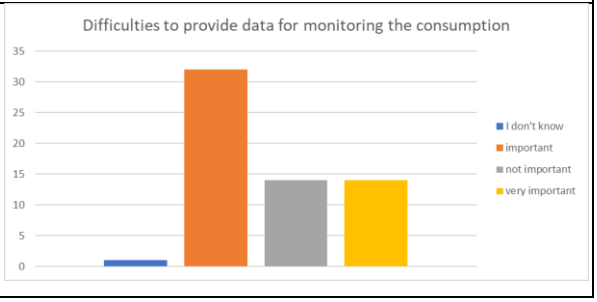

Lack of reliable and affordable technology providers
35
30
25
20
15
10
5
0
I don't know
important
not important
very important


Difficulties in the integration with the existing processes
35
30
25
20
15
10
5
0
I don't know
important
not important
very important


Cost / Lack of incentives
35
30
25
20
15
10
5
0
I don't know
important
not important
very important


Uncertainty about real performance achievements
35
30
25
20
15
10
5
0
important
not important
very important


Difficulties to access financing and subsidies
30
25
20
15
10
5
0
I don't know
important
not important
very important


Difficulties to provide data for monitoring the consumption
35
30
25
20
15
10
5
0
I don't know
important
not important
very important

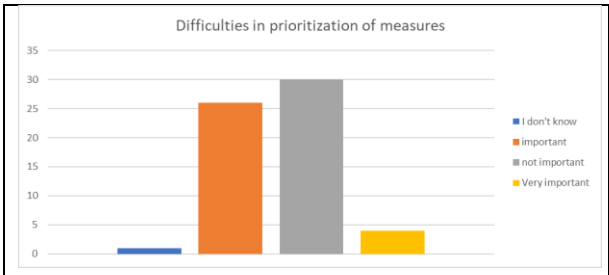


Figure 18 – Barriers in the implementation of energy efficiency measures, detail of the analysis

3.5 Drivers in implementation of measures

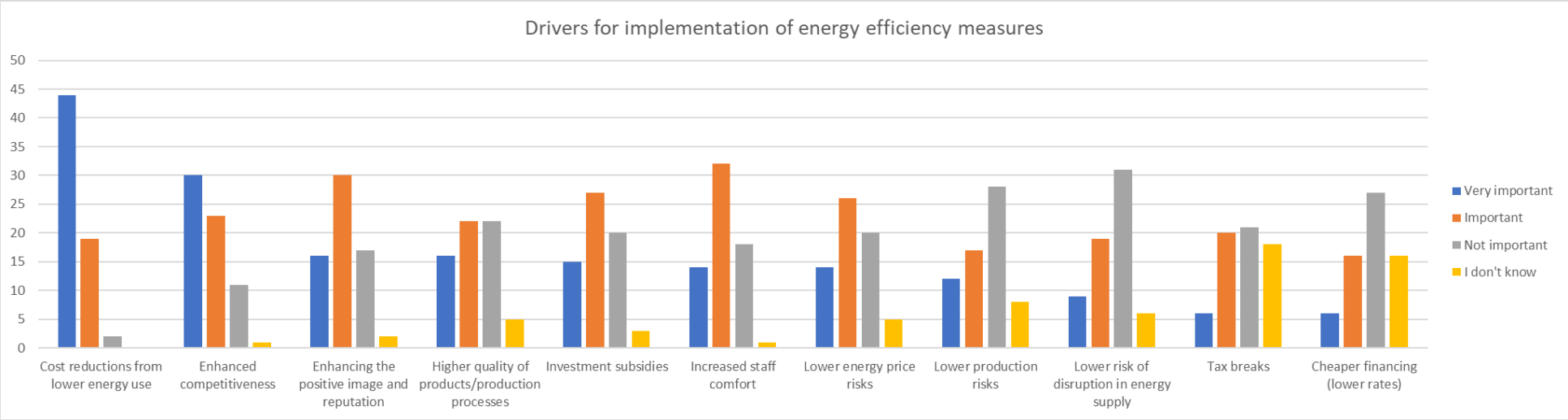


Figure 19 – Drivers in the implementation of energy efficiency measures

Cost reduction from lower energy consumption is recognized as the main driver for the implementation of energy efficiency measures, with 97% of companies considering it as important or very important. Half of answering organizations consider very important the enhance of competitiveness that can come from the adoption of energy saving measures. The positive return on the image of the organization and the increase of staff comfort are the second driver in terms of importance, while the drivers related to the production level (risk of energy supply, production risk) are considered important by less than the 50% of respondents.

Energy efficiency measure	Level of importance of the drivers for energy efficiency
Cost reductions from lower energy use	
Enhancing the positive image and reputation	
Enhanced competitiveness	
Lower production risks	
Higher quality of products/production processes	
Investment subsidies	
Increased staff comfort	
Lower energy price risks	
Tax breaks	
Lower risk of disruption in energy supply	
Cheaper financing (lower rates)	

Figure 20 – Level of importance of the drivers for energy efficiency

- The driver is considered IMPORTANT or VERY IMPORTANT by more than 70% of enterprises
- The driver is considered IMPORTANT or VERY IMPORTANT by the 50% - 70% of enterprises
- The driver is considered IMPORTANT or VERY IMPORTANT by less than 50% of enterprises

3.6 Barriers in planning of measures

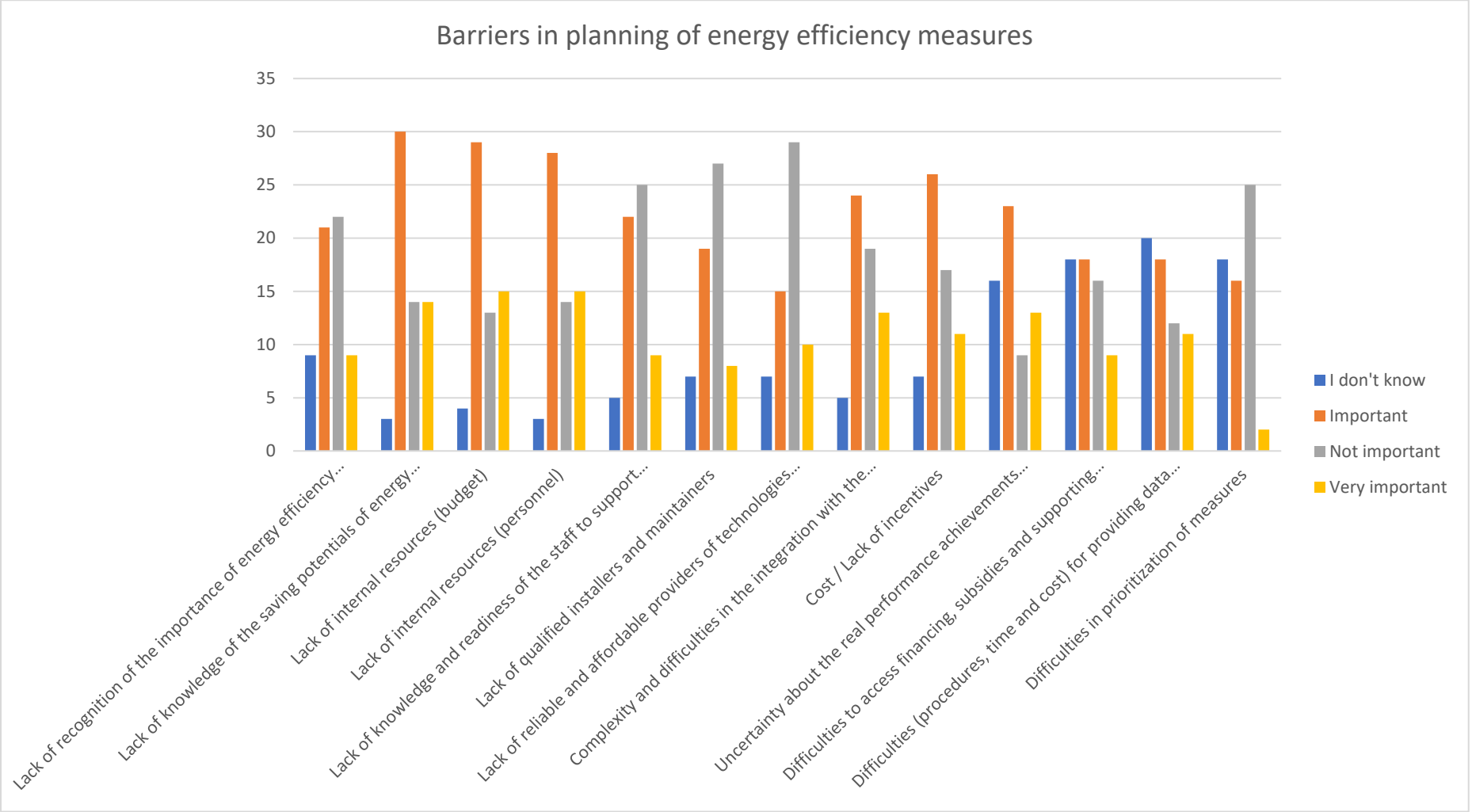


Figure 21 – Barriers in the planning of energy efficiency measures

A specific question was focused on the not planned measures, to focus on the issues that break the process of adoption of identified and potentially adoptable energy efficiency measures.

The barriers that obstacle the planning of energy efficiency measures are for the most part similar to the ones identified for their implementation. In addition, the lack of budget is considered as a relevant barrier (very important for the 19% and important for the 49%), but also the difficulties to integrate the solutions with the existing context are quire relevant.

4 Conclusions

The review of the survey results, integrated with the findings of former studies on the topic and the interviews with experts, allows to get some conclusions about the most relevant barriers to face through the IMPAWATT project and its tools.

Economic internal barriers result as the most relevant to the implementation of energy efficiency measures. More than 75% of the enterprises consider as important the lack of internal resources (personnel/budget), the cost in relation to the lack of incentives and the uncertainty about the real performance achievements. Not economic internal barrier mainly focus on the **lack of knowledge at staff level**, both in relation to the introduction of new solutions with the existing processes (68%) and in gathering energy related information for the optimization of the implementation process (74%).

The relevance and entity of energy demand and energy cost, especially for SMEs, can be an obstacle for energy efficiency. Even though the ratio between energy costs and overall costs is often important, the absolute value of energy costs is generally lower than for the larger companies, meaning that the energy saving potential and the attractiveness of decreasing the energy demand is lower. The difficulty of making economies of scale is also for smallest organizations an obstacle.

Another barrier is certainly represented by the limited organizational capacity, apparently both for SMEs and bigger companies. SMEs often don't have personnel specifically focused on energy efficiency, and ambition of individuals or trust in technology providers is often an important driver despite the lack of internal information or specific knowledge to support decisions. But the survey also evidenced that 82% of the enterprises with more than 50 of employees declares the lack of personnel as important, more than lack of budget.

In general, when financial capacity is not a critical issue, SMEs tend to accept longer payback times for investments than large companies. SMEs in fact do not strictly depend on their shareholders or split-incentives that could slow down the implementation process. This seems to be confirmed by the survey results, which show that the awareness level of the company management is even a more relevant barrier for bigger companies (55% of the total consider it important or very important) than the smaller ones (50%). In such kind of organizations the particular challenge is thus to **convince individual decision-makers** (company managers) of the benefits of improving energy efficiency with credible information, showing that the profitability of energy efficiency investments is potentially higher or the same than the one of other kinds of investment (production process).

Considering the **drivers for energy efficiency**, the survey outlines infact how the increase of **competitiveness** and the **reduction of costs** are declared as fundamental for more than 70% of respondents. Cost reduction and competitiveness are considered very important by respectively the 67% and the 46% of the enterprises. **Non-energy benefits** are not less relevant drivers: the possibility to enhance the reputation of the enterprise and a better staff comfort are considered important by the 71% of respondents, and are for sure some issues that need to be considered in the development of supporting actions.

The **supply chain aspects** and the support from manufacturers, technology suppliers, installers and ESCOs are also important in the implementation of energy efficiency processes in the industrial sector. Although 55% of respondents consider the lack of reliable and affordable technology providers not important, 51% consider the quality of installers and maintainers an important barrier.

The introduction of tools to **solve the lack of accountability** (the energy audit itself or others) could lower barriers related to behavior, organization and information, which often inhibit enterprises from implementing, evaluating or even recognizing possible energy efficiency solutions.

As outlined in some researches and recent studies, the barriers are often linked causally, and some of them (in particular the lack of accountability, no clear ownership of the processes and no sense of urgency) are root causes to the other barriers; acting on these barriers would reduce the impact of the other consequent barriers or eliminate them. [3]

The results of the survey confirmed that a big challenge is certainly represented, especially for SMEs, by the cost-related barriers. 88% of SMEs with less than 50 employees consider costs and lack of incentives as relevant, while the value for companies is up to 65%. This answer, combined with the answers related to the difficulties of respondents on managing the implementation process and support its integration with production, evidence that **hidden costs** seem to be also more relevant that the direct cost for the initial investment and the difficulties on the financial side. Process management, training of internal staff and information analysis are examples of relevant factors that could benefit from tools (like IMPAWATT ones) specifically developed to face such barriers. The reduction of such hidden costs could contribute in increasing the profitability of the adoption of the measures. [4]

Some barriers could be also more easily switched in drivers for energy efficiency, in a more global and strategic energy perspective. The performance measurement as an example, before and after the implementation of a measure, should be seen as a way to raise company awareness and better proceed in the energy efficiency improvement process.

Some studies also evidence that profitability and success of energy management is not only related to energy efficiency in relation to the technologies adopted, but also to other important factors like the connected **improvements in operation** and **process integration**.

[3] See also the research report "Barriers to Industrial Energy Efficiency" (IJESM, International Journal of Energy Sector Management, 2014): http://eprints.whiterose.ac.uk/94559/

[4] "Evaluating the barriers to specific industrial energy efficiency measures: an exploratory study in small and medium sized enterprises" (Cagno, Trianni. Journal of Cleaner Production 82 (2014))

5 ANNEX I – Questionnaire for companies and SMEs

The questionnaire was translated by each partner in its own language and submitted on line to the target organizations, by the use of Google Form application.

The questionnaire are available at the following links:

- https://goo.gl/forms/34gCsY5OU7tVNHbY2 (FRENCH)
- https://goo.gl/forms/17HrTmmi5hc8eOMk1 (SWISS)
- https://goo.gl/forms/HZN3WADJZQtcS2Ev2 (DEUTCH)
- https://goo.gl/forms/GN3lOQ58IyqIigFV2 (ITALIAN)
- https://goo.gl/forms/nOPaL9uF1QnVktId2 (FINNISH)
- https://goo.gl/forms/PEalMK9dAFAf2Zi23 (AUSTRIAN)

6 ANNEX II – List of main consulted studies and reports

ID number	Title	Web link	Type of document
1	A study on energy efficiency in enterprises: energy audits and energy management systems (European Commission, 2015)	https://ec.europa.eu/energy/sites/ener/files/documents/eed-art8-implementation-study_task12_report_final-approved.pdf	EU report
2	Barriers to industrial energy efficiency (Lunt, Ball, Levers, University of York 2014)	http://eprints.whiterose.ac.uk/94559/	International study
3	Study on energy efficiency and energy saving potential industry and on possible policy mechanism (ICF International, 2015)	https://ec.europa.eu/energy/sites/ener/files/documents/151201%20DG%20ENER%20Industrial%20EE%20study%20-%20final%20report_clean_stc.pdf	EU report
4	Management as a key driver for energy performance (Swiss National Science Foundation, 2017)	https://www.infras.ch/media/filer_public/cb/ec/cbecd922-8815-4ed4-b5b0-2b66977465fc/m_key_final_report.pdf	National report
5	Barriers, drivers and decision making process for industrial energy efficiency: a broad study among manufacturing SMEs (Trianni, Cagno, Farnè, Applied Energy volume 162)	https://www.sciencedirect.com/science/article/pii/S0306261915002639?via%3Dihub	International study
6	Barriers to industrial energy efficiency: a literature review (UN working paper, 2011)	http://sro.sussex.ac.uk/53957/1/WP102011_Barriers_to_Industrial_Energy_Efficiency_-_A_Literature_Review.pdf	International report
7	Evaluating the barriers to specific industrial energy efficiency measures: an exploratory study in small and medium sized enterprises (Cagno, Trianni, Journal of Cleaner Production 82 (2014))	https://www.sciencedirect.com/science/article/pii/S0959652614006453?via%3Dihub	International report
8	Beyond barriers – A case study on driving forces for improved energy efficiency in the foundry industries in Finland, France, Germany, Italy, Poland, Spain, and Sweden (Thollander, Backlund, Trianni, Cagno, Applied Energy volume 111)	https://www.sciencedirect.com/science/article/pii/S0306261913004376?via%3Dihub	International report
9	Success Factors of Energy Management in Energy-Intensive Industries: Energy Performance Measurement (Aalto University, 2011)	http://lib.tkk.fi/Diss/2011/isbn9789526042398/	National report
10	European Enterprises Climate Cup, IEE project, final report (2016)	http://www.enterprises-climate-cup.eu/service/information-material/	EU project report
11	Energieeffizienznetzwerke – beschleunigte Emissionsminderungen in der mittelständischen Wirtschaft" (Eberhard	https://link.springer.com/article/10.1007/s12398-010-0002-4	National report

	Jochem, Michael Mai, Volker Ott, Zeitung der Energiewirtschaft (2010)		
12	Energieeffizienz in Industrie und Kommunen – Kostenvorteile herausholen (2014)	https://www.alexandria.unisg.ch/232614/1/Fischl%20et%20al._2014_Energieeffizienz%20in%20Industrie%20und%20Kommunen_Kostenvorteile%20herausholen.pdf	National report
13	Categorizing Barriers to Energy Efficiency – an Interdisciplinary Perspective, Energy Efficiency (Thollander, Palm, Rohdin, 2010)	https://www.intechopen.com/books/energy-efficiency/categorizing-barriers-to-energy-efficiency-an-interdisciplinary-perspective	International report
14	Soluzioni regolatorie per le barriere non-economiche alla diffusione dell'efficienza energetica in italia nell'uso dell'elettricità (2012)	http://www.statigenerali.org/cms/wp-content/uploads/2012/12/3.7_GdL_Dario-Di-Santo.pdf	National report
15	Enquete de besoins OPTI'ENERGIE (2009)	http://www.drome.cci.fr/sinformer-sur/mon-entreprise-au-quotidien/industrie/objectif-environnement/la-visite-energie/?no_cache=1&tx_drblob_pi1%5BdownloadUid%5D=532	Regional report
16	STEEEP (Support and Training for an Excellent Energy Efficiency Performance), final report (2017)	http://belgianchambers.be/wp-content/uploads/2017/05/STEEEP_Final-pusblishable-report.pdf	EU project report
17	Les freins à l'investissement de maitrise de la demande d'energie (MDE) chez les industriels, ATEE (2017)	http://atee.fr/sites/default/files/2_-_atee_daniel_2017_12_12_dc_2.pdf	Regional report