INTEGRATION OF NON-ENERGY BENEFITS INTO ENERGY AUDIT PRACTICES TO ACCELERATE THE UPTAKE OF RECOMMENDED MEASURES

SUPPLEMENTARY DOCUMENT FOR THE OVERVIEW OF ENERGY AUDITING PRACTICES AT ENTERPRISES (D2.1)

06th December 2023

KNOWnNEBs has received funding from the European Union's LIFE21-CET-AUDITS programme under grant agreement no. 101076494.

Start Date	01/11/2022	Duration	36 months
Project URL	https://webgate.ec.europa.eu/life/publicWebsite/project/details/101076494		
Deliverable	Supplementary document for D.2.1 – Overview of energy auditing practices at enterprises		
Work Package	2		
Nature		Dissemination Level	*Public (D.2.1)*
Lead Beneficiary	BME (WP2)		
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Executive summary

The following chapters describe the audit schemes established in the 9 countries of the project partners. An overview table can be found in Annex 4 with cross country comparison.

In general, it can be concluded that the energy audit systems in all partner countries are well established, following the requirements of the EED Directive. National implementations have resulted in similar solutions, but with some minor differences. Many similarities can also be identified with regard to the operational shortcomings of the audit system.

For this project, the most important identifiable gap is the complete absence of a non-energy benefit indicator system, with the exception of carbon dioxide emissions, which is generally applied in all but one partner country.

Starting with the positive aspects, all partner countries have a well-established institutional framework, and the formal implementation of legislation is almost complete. Only in Austria there is a temporary gap in the functioning of the system due to the revision of the legislative background, but this is expected to be resolved soon.

The licence to audit is usually linked to a degree in engineering, but the range of qualifications allowed is quite wide. In some countries, separate qualifications are required for buildings, processes and transport; in others, the same licence may be used for all three. A specific exam is always required to get the licence.

In general, there is a specific methodology that needs to be followed to issue the certificates, but for the field work, the auditors have freedom to use the methods they want. They are mostly restricted to general guidelines to carry out the audits based on European audit standards. Although the application of standards and methods is mostly optional, each framework provides a list of minimum requirements and a data template to be filled in an online system that is stored by a central (national or regional) supervising institution.

There are no official software tools for energy audits, but in 5 countries there are official tools for issuing Energy Performance Certificates of buildings that can be optionally used for the building domain. Dynamic simulation tools for modelling buildings can be used in 8 countries, but they are rarely applied in practice, except for large complex buildings in Portugal. For industrial processes and transport,

professionals or companies make their own tools, usually in MS Excel, but in some countries more complex tools have been developed as well, which are not always publicly available. Neither questionnaire data collection nor in-depth interviews with building users are common during audits, although project partners would consider this useful and important. This is probably because such data collection is not a mandatory element of the audit protocol.

The quality check systems are working in the majority of the countries with check rates of 3-8% (in one country 68%), however, in 3 partner countries there is no protocol established for the audit procedure nor for the quality control of the data collected. In spite of the working compliance and control systems, they have limitations and often there is no assurance of the robustness of reporting data, as there is often no detailed template for reporting, nor requirements for granularity of data or for detail of the analysis. In two countries there is even no register for energy auditors, only the obligated companies are checked.

Access to the data collected during the audit is generally highly restricted, although in many countries information is provided upon request, with certain limitations. Public data transparency is therefore not common.

Only one country has an audit requirement for SMEs, and only two partner countries have to implement any of the measures recommended by the audit, and even there only a minimum effort is expected.

It can be considered as a general problem that auditors who are very highly skilled and diligent usually practice at higher rates (which is completely legitimate and reasonable), but unless the company decision makers are well aware of the effort a good energy audit requires, those auditors are at a competitive disadvantage in the market. Therefore, the robustness of the audits is not always of high confidence. Many companies do not see the added value of a good and detailed audit and therefore their concern is just about complying with the legal framework. However, the impact of the energy crisis seems to have turned the tide in all partner countries: the perception of the usefulness and necessity of audits seems to be improving.

1.1 Legislative requirements for enterprise energy audits

There are two main legislative acts on enterprise energy auditing in Latvia:

- Energy Efficiency Law[1]
- Cabinet regulation No. 487 «Regulations Regarding Energy Audit of Enterprises»[2]

The Energy Efficiency Law describes the general questions on energy auditing, but the Cabinet regulation No. 487 describes the specifics of energy auditing in enterprises. The Energy Efficiency Law states that a mandatory energy audit (or ISO 50001 or 14001 with continuous energy consumption evaluation) should be done once every 4 years in large enterprises and large electricity consumers (annual electricity consumption above 500 MWh). Cabinet regulation No. 487 state who can perform enterprise energy audits, what information should be included in these audits and how these energy audits should be registered.

1.2 Standards, norms applied in the energy auditing practice

As long as all legislative requirements regarding the energy audit content have been met, there is no specific mandatory energy auditing methodology which has to be followed. If during enterprise energy audit an energy audit of a building is performed, then the national methodology for energy performance evaluation in buildings has to be followed (ISO 52000 series standards). During energy auditing of enterprises energy auditors often choose to follow EN 16247 series parts 1 to 5 standards.

1.3 Auditing system and process

1.3.1 Executive bodies and their roles

Three types of executive bodies in enterprise energy auditing process can be allocated:

- Legislator – responsible for issuance of normative/legislative regulations – Ministry of Economics[3]
- Supervision of the execution of normative regulations - State Construction Control Bureau of Latvia[4]

[1] https://likumi.lv/ta/en/en/id/280932-energy-efficiency-law
[2] https://likumi.lv/ta/en/en/id/283807-regulations-regarding-energy-audit-of-enterprises
[3] https://www.em.gov.lv/lv/energoefektivitate
[4] https://www.bvkb.gov.lv/en/energy-efficiency

- Accreditation of energy auditors - Latvian National Accreditation Bureau[5]

1.3.2 Auditors' network

Only companies can become an enterprise energy auditor. This can be done if the company willing to become an enterprise energy auditor undergoes an accreditation process led by Latvian National Accreditation Bureau (based on EN ISO/IEC 17020). At the moment there are in total only 7 companies which have undergone such accreditation process. National legislation also in some cases allows that enterprise energy audits are performed by certified independent experts in the field of building energy efficiency (these are experts who can issue building energy performance certificates). There are about 100 certified experts but the real number of experts actually working in the field is considered to be less. These experts are allowed to perform enterprise energy audits only in case if at least 90% of total energy consumption in the company is used in buildings (space heating, DHW, lighting, ventilation and air cooling).

The companies accredited as enterprise energy auditors have to undergo yearly inspections by the Latvian National Accreditation Bureau. The costs of these inspections are around 1 to 2 thousand EUR. There are no other mandatory costs for energy auditors. For independent experts in field of energy efficiency there is a yearly fee of 216,62 EUR (for supervision of professional activity), but this fee does not include any supervision activities for enterprise energy audits. At the moment due to a loophole in national legislation there is no independent supervision of those certified experts (in the field of energy efficiency experts who are conducting energy audits in enterprises). This can lead to a lower quality of energy audits.

The main requirement to become a company who can conduct enterprise energy audits is to have competent personnel and fulfilment of all requirements stated in EN ISO/IEC 17020 for inspection body accreditation.

All accredited companies who can conduct enterprise energy audits are included in Latvian National Accreditation Bureau's database[6]. All certified independent experts in the field of energy efficiency are registered in the register of Latvian Building information system[7].

[5] https://www.latak.gov.lv/en?utm_source=https%3A%2F%2Fsearch.yahoo.com%2F

[6] https://ai.latak.gov.lv/index.php?option=com_institucijas&view=institucijas&type=all&Itemid=524&lang=en

[7] https://bis.gov.lv/bisp/lv/expert_certificates

1.3.3 Reporting, audit database

All enterprise energy audits have to be registered in the Enterprise energy audit register[8] which is a part of Latvian Building information system. By the end of February 2023 there are in total 457 entries in this register. This means that there are 457 official enterprise energy audits performed and stored in this register. The register only started working in 2020. This register contains a publicly available database which includes 4 data fields:

1. Registry number of enterprise energy audit;
2. Name of the company where the enterprise energy audit has been performed
3. Issue date of the energy audit
4. Name of company or expert who has issued the energy audit.

When an energy audit is registered in the database the energy auditor has to include information regarding energy consumption and energy efficiency improvement measures as well as indicator for specific energy consumption. These data fields are not accessible publicly and they are only accessible by State Construction Control Bureau of Latvia. This enables to perform data analysis on existing energy consumption in industries as well as potential energy savings. Each year companies which have mandatory energy audits have also to report all energy efficiency measures implemented in the company. This is done via an online system which basically started working in January 2023.

1.3.4 Compliance and control, sanctions

The compliance control of enterprise energy audit legislation is done by State Construction Control Bureau of Latvia (SCCBL). The main tasks of SCCBL include controling of mandatory energy audit issuance in large enterprises and in large electricity consumers. SCCBL each year issues a list of large enterprises and list of large electricity consumers. If a company is included in the list for 2 years in row then the mandatory requirements regarding energy auditing in enterprises have to be fullfilled. The last list of large enterprises contains 276 companies and the list of large electricity consumers contains 1086 companies. If a company does not comply to national legislation requirements regarding conduction of enterprise energy audits, an Energy efficiency duty (fee) has to be paid. The amount of the fee is 7% of the costs of electricity in a copany. Usually the fee is around 6 – 7 EUR/MWh of electricity used (the amount changes with the change of electricity prices). This means that for the large electricity consumers (with electricity consumption of 500 or more MWh per year) the amount of this fee starts with

[8] https://bis.gov.lv/bisp/lv/energy_audits/

3500 EUR. There is no maximal limit of this fee. The largest amounts usually come up to around 50,000 EUR.

For checking the quality of issued energy audits SCCBL has an automatic easy check for all energy audits (if the sum of energy sources is the same as sum of energy end-use, e.t.c.) when the energy audit is registered in the register. SCCBL can perform additional qulaity control if such need arises.

The quality of energy audits for the most part is ensured by Latvian National Accreditation Bureau yearly inspections of companies which can issue enterprise energy audits. At the moment due to a loophole in national legislation there is no quality control of those certified experts in the field of energy efficiency experts who are conducting energy audits in enterprises. This can lead to a lower quality of energy audits. It is foreseen that this legislation loophole in the next 2-3 years will be fixed.

1.4 Audit content

1.4.1 Content

The energy balance of the enterprise shall be the basis for the energy audit of an enterprise. The total volume of energy indicated in the section of energy sources in the energy balance of the energy audit of an enterprise must coincide with the total energy consumption indicated in the section of energy consumption. The energy consumed for the production of the energy transferred to other users need not be included in the section of energy sources. In such case the total energy consumption does not include the energy produced by the enterprise which is transferred to other users. The following energy sources and volumes of energy obtained therefrom shall be separately indicated in the energy audit of an enterprise:

- purchased electricity;
- thermal energy purchased from a district heating system;
- energy produced at the enterprise (the volume of the energy produced from each type of fuel must be indicated separately by separating thermal energy and electricity);
- thermal energy purchased or received from another supplier.

The following energy consumers and energy volumes shall be separately indicated in the energy audit of an enterprise:

- energy consumed for heating of buildings owned or used by the enterprise;
- energy consumed for the preparation of the hot water necessary for household needs;
- energy consumed for lighting;
- electricity consumed for the operation of ventilation systems;

- energy consumed for the cooling of premises;
- electricity consumed in industrial processes;
- thermal energy consumed in industrial processes;
- other energy consumers.

While performing energy audit energy auditors visit the companies. Usually some measurements (temperatures, equipment energy use, indoor air CO_2 levels, light intensity, e.t.c.) are performed by energy auditors but those are not mandatory measures. There are no mandatory measures to be performed. Therefore the quality of energy audit usually is strongly dependant on the experience and competence of the energy auditor.

The followings shall be included in the energy audit report of an enterprise:

- the list of persons who conducted the energy audit of an enterprise;
- compiled initial data (description of the current situation, energy balance, energy flow charts, description of technological processes, annual energy consumption, annual energy costs);
- results of the initial data analysis on the basis of the determination of the specific energy consumption of the enterprise;
- proposals for energy efficiency improvement measures;
- results of the cost-benefit analysis (economic assessment of the identified energy efficiency improvement measures and justification of priority measures);
- if it is economically justified, the analysis of the costs of the life cycle of identified energy efficiency improvement measures.

When performing enterprise energy audit often energy auditors will often issue EPCs for the buildings where the enterprise is located but it is not a mandatory requirement. Often in enterprise energy audits already existing EPCs will also be taken as input data for creating energy balance of the enterprise.

The content of energy audit is described but there is no mandatory template on how the energy audit should look. Therefore, the energy auditors are creating their templates for enterprise energy audits.

1.4.2 Non-energy benefits

There are no mandatory non-energy benefits which have to be included in energy audits. Usually, energy audits contain CO_2 emission calculations. In some cases other non-energy efficiency benefits are included based on requirements from the companies which are being energy audited. Usually, the increased productivity is included on the energy audits since companies are willing to replace old equipment with newer more productive equipment. Larger equipment usually consumes more energy in absolute units. Therefore, in energy audits specific energy consumption is taken into account if more productive equipment is to be installed and replace the existing one.

In recent years companies are showing interest in improved air quality due to energy efficiency improvement measures. But this in energy audits usually is reflected just by a sentence that the indoor air quality will be improved.

1.4.3 Quality and presentation

There is no clear benchmark on the quality of energy audit. It is mostly dependant on the competence level of energy auditors. Since in some cases energy audits in enterprises can be done by independent experts in field of energy efficiency of buildings the quality of energy audits can be rather low. If client wants to receive a very in depth analysis in the energy audit they usually go to accredited companies which can make energy audits and the quality of audits is better.

In energy audits the estimated savings usually are quite low if compared to total energy consumption in the audited company. This is largely because energy audits in enterprises are mostly done in order to fulfil legal requirements. Therefore, such easy measures as change of lighting are suggested. In the last years companies, which have to be audited start to concentrate on inclusion of more energy efficiency measures in energy audits due to rapid increase of energy tariffs.

In most cases there is no specific detailed way how companies are addressed when the energy audit results are presented. Due to fact that most of enterprise energy audits are carried out only in order to satisfy legal requirements, enterprises in some cases even do not really have a look at the suggested measures. Most often enterprises ask if the measures suggested in energy audit are enough to satisfy legal requirements. If a company will have an energy audit for other reasons than just legal requirements then the results of energy audit are usually presented to the enterprise. In most cases the technical persons from the company are involved in this presentation of results. Then they go to the company decision makers and relay the results of energy audit. Certainly, there are a lot of different cases where the top management of company also is involved in presenting the results of energy audit. Typically, the estimated energy savings and cost savings are presented. The costs of energy efficiency measures are included in many cases (but not always). Therefore, also the payback period of certain energy efficiency measures is not indicated.

1.5 Audit market

The costs of performing the energy audit are largely dependant of the type of company which has to be audited. Usually, the cost of enterprise energy audit starts at around 2.500 EUR and goes up to around 10,000 EUR. It usually covers the large electricity consumers with electricity consumption of more than 500 MWh per year. In case of large companies, the costs of energy audits will be higher (typically up to 20,000 EUR) if the large company has a large energy consumption and multiple sites. Energy audit usually takes 2 to 3 months to perform. There are

two types of companies willing to perform energy audit: (1) large companies and large energy electricity consumers, which are obliged by law to do these energy audits and (2) companies applying to any type of subsidy schemes for improving energy efficiency in the enterprises. Enterprises, which want to perform energy audit just because they want to decrease their energy consumption and costs, are not that common (this has changed slightly due to recent spikes in energy and fuel costs). In total there are 276 large companies and 1086 large electricity consumers which are obliged to do an energy audit (or energy management system or improved environmental management system). There is no official statistics available, but it seems that quite a lot of companies choose the introduction of an energy management system instead of energy audit. Since the energy audit is mandatory most often companies do not see it as a real opportunity to save energy consumption and reduce costs. Also, the national legislation foresees that companies have to mandatory implement 3 energy efficiency measures in the 4 year period between renewal of energy audits. It is not stated what is the minimal amount of energy to be saved by implementing these 3 energy efficiency measures (in theory you can change one light bulb and it will count as a measure). Each year companies have to report the implemented energy efficiency measures and achieved energy savings.

When it comes to selecting energy auditor – most often companies send price requests to some energy auditors and the cheapest offer is chosen. This also does not contribute to high quality of energy audits.

1.6 Calculation methodologies, tools, templates

There are no mandatory templates, calculations tools and methodologies which have to be used in energy audits of enterprises. As long as the required mandatory content of energy audit is fulfilled the energy audit can be done quite freely. In real life energy auditors tend at least to partly follow methods described in ISO 52000 series standards and in EN 16247 series parts 1 to 5 standards. Each energy auditor develops their own tools, templates, questionnaires in order to perform the energy audit. For calculation tool an Excel file usually is developed by the energy auditor. In some specific cases already existing calculation tools (TRNSYS, IDA ICE, e.t.c.) can be used to achieve specific goals set in the energy audit by the client.

1.7 Best practice examples

The user-friendly approach of the Latvian supervisor of implementation of the energy audit legislation (State Construction Control Bureau of Latvia) should be stated as best practice example when it comes to contacting with the companies which have to have energy audits. SCCBL frequently organizes workshops and

seminars for energy auditors as well to companies on the changes in legislation, introduction of new systems (like Energy Efficiency Monitoring System), new methodologies, e.t.c.

1.8 Summary

Energy audits in enterprises in Latvia really started around 2017 when the legislation on mandatory energy audits was approved. Since the energy audits are mandatory some negative aspects are still following the issuance of energy audits and companies rarely see the energy audits as an opportunity, but they more often see it as a burden. Due to recent energy and fuel costs increase also a shift in attitude of companies can be seen.

1.8.1 Strengths

The energy auditing system in Latvia is working and energy audits are being performed for the companies with the mandatory obligation for energy audits.

1.8.2 Weaknesses

Energy audits for companies which are not involved in the mandatory energy audit scheme are not performed that often.

Non energy benefits basically are not taken into account when preparing an energy audit.

Since there are no official mandatory templates, calculations methodologies and tools the quality of an energy audit is strongly dependant on the competence of energy auditor.

Since the main goal of most of the energy audits is just to fulfil legal requirements, the energy efficiency measures included in the energy audits usually cover only the most obvious measures (like change of lighting or building envelope insulation).

2 Hungary

2.1 Legislative requirements for enterprise energy audits

There are two main acts on energy audits in Hungary. General rules are regulated by the ’2015 - LVII. Law about energy efficiency’[9] and details are specified in the ’Executive Decree: 122/2015. (26 May) Govt. decree, the law on energy efficiency on its implementation’[10]. These acts cover all aspects of the EED and do not include additional requirements.

Building energy audits often include energy calculations and energy requirements that are specified in the ‘7/2006 (24 May) TNM decree on the energy performance of buildings’[11], although the use of this method is not mandatory for audits. In addition, the ‘176/2008 (30 June) governmental decree’[12] on the energy performance certification of buildings should also be mentioned as EPC can also be an additional element of an audit.

2.2 Standards, norms applied in the energy auditing practice

The European audit standards (MSZ EN 16247 series parts 1 to 5, MSZ EN ISO 14001, MSZ EN ISO 16001, MSZ EN ISO 50001) are translated and widely used in Hungary. For buildings no calculation method is prescribed, but in practice auditors use the method of the 7/2006 (V.24.) decree on energy performance of buildings, which is developed for EPC calculations.

[9] 2015. évi LVII. törvény az energiahatékonyságról, https://net.jogtar.hu/jogszabaly?docid=a1500057.tv

[10] 122/2015. (V. 26.) Korm. rendelet az energiahatékonyságról szóló törvény végrehajtásáról, https://net.jogtar.hu/jogszabaly?docid=a1500122.kor

[11] 7/2006 (V.24.) TNM rendelet az épületek energetikai jellemzőinek meghatározásáról, https://net.jogtar.hu/jogszabaly?docid=a0600007.tnm

[12] 176/2008. (VI. 30.) Korm. rendelet az épületek energetikai jellemzőinek tanúsításáról, https://net.jogtar.hu/jogszabaly?docid=a0800176.kor

2.3 Auditing system and process

2.3.1 Executive bodies and their roles

The Hungarian Energy and Public Utility Regulatory Authority[13] (MEKH, in the followings: Authority) is the coordinator organisation of the Hungarian energy auditing system implementation and management. More specifically the Authority is responsible for

- the development and registration of the auditting network
- supervision of the auditting network
- quality control (compliance and control) of the energy audits
- other specific tasks.

The only tasks which are dedicated to another organisation is the education of the auditors and the execution of exams. These tasks are carried out by the Hungarian Chamber of Engineers.

2.3.2 Auditors' network

Auditors can be independent experts or companies that employ at least one licensed expert. Licensed experts must have an MSc degree as defined in the law (e.g. energy engineer, mechanical engineer, electrical engineer, architect, civil engineer) and 5 years of professional experience. In addition, they must attend a two-day course and pass a written exam consisting of three parts (a technical, a computational and a legal part) and pay a registration fee (approx. €125 for individuals, €500 for companies).

To register as an expert, the following must be submitted to the authority: examination certificate, registration fee, certificate of professional competence, certificate of professional experience, language skills.

To keep their licence, experts must attend a one-day training course every year, take a renewal exam every 5 years and pay an annual fee (around €125/year for individuals, €1000/year for companies).

In January 2023, the number of registered individuals was 170 and the number of registered companies 86. There are about 40 active auditors. Most auditors' core competences are limited to industrial processes and relatively few have a basic knowledge of buildings.

[13] http://mekh.hu/home

2.3.3 Reporting, audit database

The inspection reports must be stored by the audited company and the auditor (and presented in case of a quality inspection), but a detailed, pre-defined set of data must be uploaded to the Authority's online platform. The dataset can only be uploaded by authorised auditors and the system has automatic checking routines to filter out data outside the realistic range. This data is used by the Authority for statistics and quality checks.

The database is not public, but limited access to the data is available on request.

2.3.4 Compliance and control, sanctions

Quality control falls within the competence and responsibility of the Authority. The quality control department divides the inspections according to the 3 domains: technology, buildings and transport.

The levels of control are:

1. Verification of digitally uploaded data: it is the responsibility of the legal department and covers compliance with deadlines, eligibility issues (e.g. real company tax number). In the case of deficiencies, a request for a correction is issued.

2. Professional pre-check: mandatory content verification (audit should include all three areas - buildings, processes, transport).

3. For randomly selected audits (no audit rate required by law), controllers request and check the full audit documentation, and in case of deficiencies, they ask for a correction that should be submitted within 6 months (notification to both company and auditor).

If the correction of the deficiency is inadequate or in case of a fraud, the fine is always issued on the large company, but the auditor may also be sanctioned. They are first warned, then disqualified, first for 3 years, then permanently. The large company can also sue the auditors for a fine imposed, so auditors have the option of taking out liability insurance. Auditors may also be suspended for administrative failure, in which case they must retake the exam and apply for revalidation.

2.4 Audit content

2.4.1 Content

The audit should cover all three areas (transport, buildings and processes). It should include an assessment of energy consumption (including load shifting

options). An analysis of the applicability of renewable energy sources, such as recommendations for more efficient operations, is mandatory. For buildings, an asset calculation method based on building physics parameters shall be used, based on the national calculation rules (Regulation 7/2006). The proposed measured retrofit and energy savings and associated costs shall be included in the following structure:

- measures not requiring investment (simple),
- measures that can be economical without any subsidy (cost-optimal),
- measures currently only realistic with subsidies (costly)

An economical analysis is also required, but simple payback times are sufficient. Interviews, other measurements are not mandatory. There is no official template for documentation, only the dataset uploaded to the official platform has a mandatory structure and content.

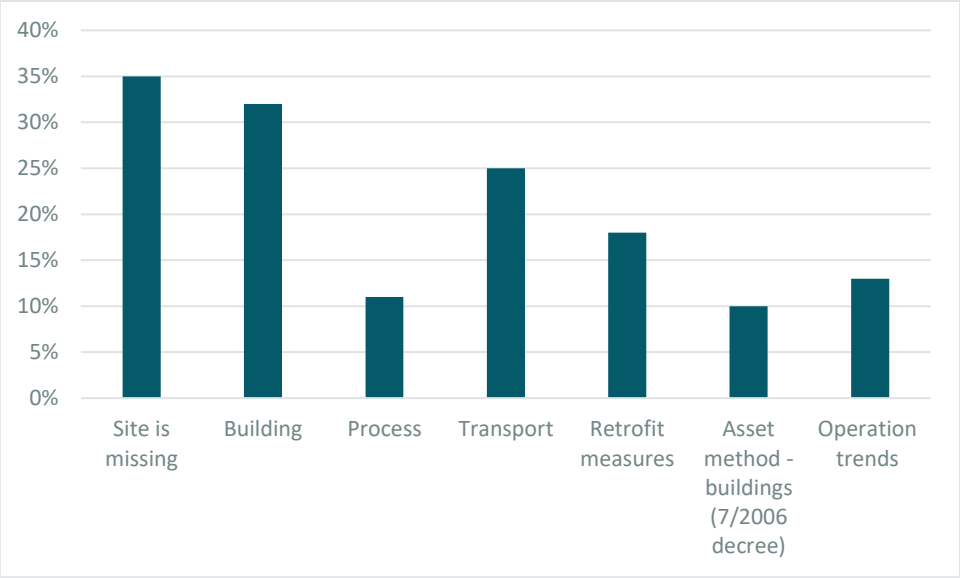
2.4.2 Non-energy benefits

The only mandatory non-energy benefit indicator is carbon-dioxide emission.

The recommended retrofitting measures should comply with all normative requirements, including indoor air quality and comfort. A mandatory part is the awareness raising of the employees of the large company, which should be carried out by the auditor. This has no minimum requirements and usually involves guidelines and possibly short training sessions.

2.4.3 Quality and presentation

The problems detected by quality checks is presented in the figure. The indicated percentage is related to the total number of checked audits. The most frequent problem was that one of the company sites were missing. (The rules allow the exclusion of sites which are responsible for less than 10% of the total consumption.) It was also frequent that one of the three compulsory audit components (buildings, industrial processes or transport) was missing.



Problems detected by quality checks

The quality of the audits shows an improving trend due to the quality control, strict sanctions and continuous education.

2.5 Audit market

There are cca. 5200 large companies in Hungary. The first audits were uploaded in November 2015, the quality checks started early 2017. Until end of 2022 altogether 2722 mandatory large company audits have been issued and 215 have been checked by the Authority.

Audits are mandatory for large companies only. If a company has more than one site, only those sites that consume more than 10% of the company's total energy consumption need to be audited. It is possible to apply the so-called typology method: if there are sites with similar characteristics, the results of one site can be applied to the others.

The typical cost for a 5000 m^2 building without any industrial process and transport is cca. 4000-6000 euros, but it can vary in a wide range.

Public buildings are obliged to carry out an energy efficiency implementation plan every five years, which can be considered as a simplified audit. Public organisations have to submit an energy performance report annually to the Authority about their buildings. They have awareness raising obligations as well.

Companies can select auditors from the official list of auditors published on the website of the Authority.

The realization of energy saving measures listed in the audits are not mandatory in Hungary. There hasn’t been any market research on what level the recommended measures of the audits have been implemented later.

If a large company has an energy management system that complies with ISO 50001, it does not need to carry out audits. The cost of an ISO 50001 energy report is about one third of the cost of an audit, but it has to be carried out annually instead of every four years. So the overall cost of implementing an energy management system is higher. Therefore, most companies prefer to have an audit. ISO 50001 is only applied to industrial processes, not to buildings.

Although there have been no representative surveys about this issue, there is a general impression that before the energy crisis companies considered the energy audits just an obligation. However, since the crisis there have been a great increase in demand for energy advices in all sectors.

2.6 Calculation methodologies, tools, templates

There are no formal templates or tools for energy audits. However, the online reporting platform operated by the Authority has a fixed structure and creates a detailed data structure for the setup.

For buildings, the asset calculation method is defined in Decree 7/2006 (24.V.2006) and there are two market-based software (Winwatt and Auricon) which are used in most cases.

For the other parts of the audit auditors and auditing companies use their own templates and calculation sheets.

Questionnaires and surveys are not used in the general practice, except for some auditors who use their own templates.

2.7 Best practice examples

BME was involved in the Interreg CE Together project. In this projects 9 public buildings were investigated. The pilot buildings were audited, smart meters were installed, but the main the focus was on occupant behaviour and awareness raising. It included social audits, trainings and occupancy patterns were monitored. A main conclusion of the project was that the usefulness of an audit can be significantly improved if technical audit is supplemented with a communication and education campaign towards building users.

2.8 Summary

Although energy audits have been carried out for decades in Hungary on a voluntary basis, it is mandatory only since 2015, and only for large companies. The legislative framework and the realisation strictly follows the energy efficiency

directive. The EED requirements are met, the system is working, but it does not contain any elements that go beyond the ambition of the Directive.

2.8.1 Positive aspects

The level of difficulty of the auditor requirements and examination system is well adjusted, so there is an adequate number of auditors (not too few and not too many). From a qualitative point of view, the required MSc degree and the long professional practice period of 8 years are also positive in terms of the auditor's input requirements. The quality control system also works well and the sampling rate is relatively high. The data recording platform for audits is also adequate and collects data in sufficient detail (which is not the case for the building energy certification). The energy crisis seems to have increased the interest towards energy audits and the willingness to implement the proposed measures, although no representative survey has been carried out so far.

2.8.2 Negative aspects

One problem is that the competence requirements cover three different areas of expertise (industrial processes, buildings, transport) and there is no specialised auditor status. While this may have a filtering effect on candidates, it would probably be better from a quality point of view to have a specialised auditor system for each field. The number of auditors qualified in building science is very low and a harmonised application of energy certification and auditing should be considered.

Another disadvantage is that the responsibilities of auditors are too great and growing, so there is a risk that they will turn to other activities.

The quality of energy audits is variable and the motivation of companies was rather low until the energy crisis.

Finally, the current system takes almost no account of non-energy benefits.

3 Portugal

3.1 Legislative requirements for enterprise energy audits

There are four main acts for energy audits in Portugal:

- **Law no. 7/2013**[14]**,** of January 22, which approves the access and exercise regime of the activities of conducting energy audits, preparation of energy consumption rationalization plans and control of its implementation and progress, including through the issuance of implementation and progress reports, under the Management System for Intensive Energy Consumption (SGCIE) and within the scope of application of the energy consumption management regulation for the transport sector, approved by Ordinance no. No. 228/90, of 27 March, amending Decree-Law No. 71/2008, of 15 April;
- **Law No. 58/2013**[15]**,** of 20 August, which approves the requirements for access and exercise of the activity of qualified expert for energy certification and technician of installation and maintenance of buildings and systems, conforming it to the discipline of Law No. 9/2009, of 4 March, which transposed Directive No. 2005/36/EC of the European Parliament and of the Council of 7 September 2005 on the recognition of professional qualifications;
- **Decree-Law n.º 68-A/2015**[16] of 30 April 2015 in force from 01 May 2015 which transposes the Energy Efficiency Directive (Directive 2012/27/EU). According to this regulation, enterprises that are not SMEs are subject to an energy audit by 05/12/2015 and at least every 4 years from the date of the previous energy audit, in main facilities with aggregate consumption above 250 toe/year. A company is considered to be any entity that is established with an economic activity of offering goods and services regardless of its legal form. Moreover, in the first stage, this regulation requires all non-SMEs, with or without an audit, to register the energy consumption of their facilities in the existing SGCIE platform, every 4 years.
- **Law No. 75/2015**[17], of 28 July, which approves the regime of access and exercise of the activity of provision of auditing services of production facilities in cogeneration or production from renewable energy sources.

In addition to this regulation, following the first energy crisis of the 70s and several legislative acts since then, the first Regulation for the Energy Consumption Management (RGCE)[18] entered into force by DL 58/82, defining the terms and conditions for the energy intensive companies (>1000 toe), as well as establishing

[14] https://files.dre.pt/1s/2013/01/01500/0045300462.pdf.
[15] https://dre.pt/dre/detalhe/lei/58-2013-499236
[16] https://files.dre.pt/1s/2015/04/08401/0000200052.pdf

[17] https://dre.pt/dre/detalhe/lei/75-2015-69879420.
[18] Regulamento de Gestão do Consumo de Energia (RGCE), DL58/1982

the conditions for the auditors, and for auditing procedures. By that time and considering the specificities of the transport sector compared to energy intensive industries and services, a specific regulation was created for this sector, the Energy Consumption Management Regulation for the Transport Sector (RGCEST)[19], imposing binding energy audits, 3-year periodicity in companies with fleets consuming above 500 toe/year. The transport sector is out of the scope of this report and such information is not presented in detail.

Regarding the industrial sector and anticipating the need for improving the energy efficiency of the final energy use, with the Directive nº 2006/32/CE, the Portuguese government launched the National Energy Efficiency Action Plan (2008-2015)[20] which included a specific program for the industry, replacing the existing RGCE: **Management System of Intensive Energy Consumers (SGCIE)**[21]. Integrated into the NEEAP, SGCIE was created by Decree-Law 71/2008 of April 15th and is still in effect, although it has evolved over the years. This system aims at the promotion of energy efficiency and energy consumption monitoring in intensive energy facilities, consuming more than 500 toe/year (broadening the scope of the previous regulation, RGCE, which targeted companies with consumption above 1000 toe/year).

SGCIE applies only to energy-intensive facilities whose annual energy consumption is equal to or higher than 500 toe (or 5.8 GWh) (art. 2 DL 71/2008). However, installations with energy consumption of less than 500 toe/year or buildings in the previous situation may, on a voluntary basis, apply the SGCIE and enter into Energy Consumption Rationalization Agreements with DGEG (art. 2 of DL 71/2008). Until 30th April 2015, SGCIE imposed binding energy audits, with a 6-year periodicity, in intensive energy facilities with consumptions above 1000 toe/year. An 8-year periodicity for energy audits was applied to facilities with energy consumptions comprised between 500 and 1000 toe/year. Energy intensive installations with an annual consumption of 500 toe or less than 1000 toe must perform energy audits every 8 years, with the goal of reducing the Energy Intensity and Specific Energy Consumption by 4% and maintaining the carbonic intensity. Installations with an annual consumption equal to or greater than 1000 toe must perform energy audits every 8 years, with the goal of reducing the Energy Intensity and Specific Energy Consumption by 6% and maintaining the Carbon Intensity (art. 6 DL 71/2008).

For buildings, another legal framework (DL 101-D/2020)[22] is in place. Mandatory energy audits in buildings are connected to the Building Certification

[19] Regulamento da Gestão do Consumo de Energa para o Sector dos Transportes, Portaria n228/90
[20] RCM nº80/2008
[21] https://sgcie.pt/
[22] Sistema de Certificação Energética de Edifícios, transpondo a Diretiva (UE) 2018/844 e parcialmente a Diretiva (UE) 2019/944.

System[23] (SCE). This regulation establishes the requirements applicable to buildings for the improvement of their energy performance and regulates the Energy Certification System for Buildings. To obtain an Energy Performance Certificate, an energy assessment needs to be carried out by an accredited SCE technician (DL 101-2021)[24] following a specific auditing methodology. The Buildings Certification framework has its own rules and regulations, both for the audit procedures and for the experts' qualification/certification (**Law n.º 102/2021**, of 19 November[25]).

3.2 Standards, norms applied in the energy auditing practice

The international ISO standard 50002:2014[26] which specifies the process requirements for carrying out an energy audit in relation to energy performance is applied in Portugal. It applies to all types of establishments and organizations, and all forms of energy and energy use.

For industry, there is an extensive guide[27] for the implementation of energy audits. For buildings, ADENE provides a series of training courses[28] that are recommended for the experts carrying out the audits.

3.3 Auditing system and process

3.3.1 Executive bodies and their roles

The Directorate General of Energy and Geology (DGEG[29]) is the Portuguese Public Administration body that has the mission of contributing to the design, promotion and evaluation of policies related to energy and geological resources, aiming for sustainable development and ensuring the security of supply. In relation to the energy auditing system, DGEG has the overall responsibility of coordination, supervision and inspection. The operational management is under the responsibility of the National Energy Agency (ADENE).

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[23] https://www.sce.pt/
[24] https://files.dre.pt/1s/2021/11/22500/0000600015.pdf Estabelece os requisitos de acesso e de exercício da atividade dos técnicos do Sistema de Certificação Energética dos Edifícios
[25] https://dre.pt/dre/detalhe/decreto-lei/102-2021-174614573 Estabelece os requisitos de acesso e de exercício da atividade dos técnicos do Sistema de Certificação Energética dos Edifícios
[26] https://www.iso.org/news/ref2248.html
[27] https://sgcie.pt/manual-de-auditorias-energeticas/
[28] https://academia.adene.pt/
[29] https://www.dgeg.gov.pt/en/dgeg/mission-domains/

SGCIE: The intervening parties in SGCIE are the Directorate-General for Energy and Geology (DGEG), the Tax and Customs (AT), the Energy Agency (ADENE) and the operators who operate the installations, as well as the technicians carrying out energy audits, drawing up energy consumption rationalisation plans and monitoring their implementation and progress.

Supervision and Inspection are the responsibility of DGEG; Operational management is under the responsibility of ADENE. AT grants and control the ISP exemptions.

DGEG approves the Energy Consumption Rationalization Plans which became Rationalization Agreements for Energy Consumption (ARCEs), giving to operators´ facilities excise duties exemption (ISP) on oil and energy products (coal, oil coke, fuel oil and oil gases) and the possibility to apply for incentives on energy audit costs and on investments in energy management and monitoring equipment.

SCE: Supervision and Inspection are the responsibility of DGEG; Operational management is under the responsibility of ADENE.

3.3.2 Auditors' network

Who can be an expert?

Energy auditors must be recognized by DGEG[30]. To apply for the certification, experts have to comply with some requisites, such as: having an academic degree in engineering (mechanical, electrical, civil) or architecture and 5 years of professional experience. In addition, they have to attend a training course and pass the evaluation exam. This auditors' Certification procedure is regulated by specific legislation (Law nº 7/2013). Only recognized Technicians can provide Energy Audits and prepare Energy Consumption Rationalisation Plans (PREn) and the respective Implementation and Progress Reports (REP). However, there is no protocol established for the audit procedure nor for the quality control of the data collected; certified auditors are provided with a list of general guidelines to carry out the audits. There is no assurance of the robustness of reporting data, as there is no template for reporting, nor requirements for granularity of data or for detail of the analysis, etc.

The accreditation is given to individuals and not to a company. Auditors who are very professional and diligent usually practice higher rates (which is completely legitimate and reasonable), but unless the CEO or Directors are well aware of the effort a good energy audit requires, those auditors are at a competitive disadvantage in the market. Therefore, the robustness of the audits is not always of high confidence.

For the certification of the buildings, **SCE** technicians are independent professionals who work in the Energy Certification of Buildings (recognised by

[30]https://sgcie.pt/sistema-de-gestao-dos-consumos-intensivos-de-energia/informacao/reconhecimento-de-tecnicos/

ADENE) and carry out their activity as Qualified Experts (QP) for energy certification or as other SCE Technicians (TRM, TGE and TIS) for the installation and maintenance of buildings and systems, as well as the management of building energy consumption and periodic inspection of technical systems covered by the SCE.

Costs of being an expert

There is a pool of eligible auditors under DGEG for SGCIE and another under ADENE for SCE.

As provided in Ordinance no. 111/2015, of April 21, under the scope of SGCIE, experts have to request the recognition for accreditation by filling in a specific form and have to pay the following fees:

- EUR 240, for the assessment of requests for recognition and registration of technicians, due once at the time of submission of the respective request;
- EUR 10, for the issue of identification cards of recognized and registered technicians, due after the acceptance of the application referred to in the previous bullet and within 30 days after the notification of the respective charging document.

What are the requirements?

SGCIE: To be certified for SGCIE, auditors need to be recognized by DGEG[31] according to their academic education and professional experience. This is regulated in specific legislation (Law nº 7/2013[32]) according to the background requirements (engineer…), years of experience and taking a training course provided by ADENE with a positive evaluation in the final exam.

SCE: To become a SCE Expert, technicians have to comply with background and experience requirements and need to pass an exam provided by the National Energy Agency ADENE, which is the Executive Body of this system. The DL nº 102/2020[33] establishes the requirements and the rules for the activity of the technicians. SCE technicians are independent professionals who work in the Energy Certification of Buildings (recognised by ADENE) and carry out their activity as Qualified Experts (QP) for energy certification or as other SCE Technicians (TRM, TGE and TIS) for the installation and maintenance of buildings and systems, as well as the management of building energy consumption and periodic inspection of technical systems covered by the SCE.

[31]https://sgcie.pt/sistema-de-gestao-dos-consumos-intensivos-de-energia/informacao/reconhecimento-de-tecnicos/

[32] https://files.dre.pt/1s/2013/01/01500/0045300462.pdf regime de acesso e exercício das atividades de realização de auditorias energéticas

[33] https://files.dre.pt/1s/2021/11/22500/0000600015.pdf

Registry of energy auditors

SGCIE: There is a pool of eligible auditors under DGEG site[34]

SCE: Energy auditors qualified for carrying out the work can be selected from an official portal[35].

3.3.3 Reporting, audit database

Reporting obligations of companies

Facilities operators are obliged to conduct an energy audit and elaborate an Energy Consumption Rationalization Plan (PREn), establishing targets for energy and carbon intensity and specific energy consumption and including the energy rationalization measures. They have to present this through a website[36] to the Directorate General of Energy and Geology (DGEG), as well as biennial execution and progress reports. Upon DGEG's approval (which is the competent authority that supervises and inspects SGCIE operation) the PREn becomes a Rationalization Agreement for Energy Consumption (ARCE).

The ARCE gives to facility operators excise duties exemption (ISP) on oil and energy products (coal, oil coke, fuel oil and oil gases) and the possibility to apply for incentives on energy audit costs and on investments in energy management and monitoring equipment.

Exemptions in excise duties are foreseen on the national budget for fuels used either by consumers committed to the reduction of CO_2 emissions in the framework of the European Union Emissions Trading Scheme (EU ETS) or by consumers that have a Rationalization Agreement for Energy Consumption.

Facilities under EU ETS are not covered by SGCIE, but they can voluntarily join it, as well as facilities with annual energy consumptions lower than 500 toe.

How are audits stored?

The companies covered by this obligation must register themselves on SGCIE's Portal. To store the audits, they must log in using the 'user' access credentials and, in the "Efficiency" tab, choose the "Consumption Register" menu. In this menu, they should select the premises subject to energy audit, introduce the measures of rational use of energy resulting from it and upload the audit report.

The information on the audits has to be submitted in different electronic platforms because each system has its own platform: for each industrial site in SGCIE, for the buildings in SCE, and for the fleet in the fleet platform.

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[34] https://sgcie.pt/bolsa-de-tecnicos/
[35] https://www.sce.pt/pesquisa-de-tecnicos/
[36] http://sgcie.publico.adene.pt/

Companies have to present the audit information through the websites to the Directorate General of Energy and Geology (DGEG), as well as biennial execution and progress reports.

What data are collected?

No energy monitoring and reporting templates are set up; there are no mandatory requirements for energy audits and only guidelines or recommendations are provided. There are only checklists of the minimum information to be collected; no requirements for granularity of data, etc.

There are no mandatory questionnaires during energy audits.

What purpose data are used for, by whom?

SGCIE: The energy auditor collects as much data as needed for designing the Energy Consumption Rationalization Plan in order to achieve at least the ceiling reduction targets that are established by the law, for energy and carbon intensity and specific energy consumption. This plan is designed to include and identify cost-effective measures which should be implemented during the period before the next audit.

SCE: The data are used to issue the Certificate, identify potential energy efficiency improvements to be carried out and provide a list of recommendations. However, there is no obligation to implement the measures, until the property is sold or rented.

Accessibility of data

Only aggregated data/statistics are publicly available.

All data is collected by ADENE through several platforms but the collected data in each audit is not publicly available.

SCE: The data is centrally registered in the EPC platform, which is managed by ADENE and is used for statistics.

3.3.4 Compliance and control, sanctions

Number of checks, number of sanctions

About 68% of audits were inspected during the last 3 years (373 inspections / 551 audits), and 23 penalties and 1 administrative offense were issued in 2020-2021 representing a total fine of €70.000.

Controlling process

The monitoring of this system will be made through the execution and progress reports that have to be present every 2 years. Penalties are foreseen for those who do not meet the targets.

Energy audits, Energy Consumption Rationalization Plans and biennial execution and progress reports have to be elaborated by auditors recognized by DGEG

according to their academic education and professional experience. This is regulated in specific legislation (Law nº 7/2013). At the current days, there are 213 auditors listed in the SGCIE database. The recognition of technicians qualified to perform energy audits, preparation of energy consumption rationalization plans (PREn) and control of its implementation and progress, including the preparation of implementation and progress reports (REP), is an integral part of the DGEG's activity under the SGCIE.

The DGEG shall control the execution and progress of the ARCE, namely through the analysis of the Execution and Progress Report (REP) relative to the last period of validity of the ARCE, which must include the final balance of the execution of all of it, which shall be considered as final.

Sanctions

There are penalties for non-compliance with Decree-Law 68-A/2015. Article 31 of Decree-Law No. 68-A/2015 provides for the establishment of administrative offences, punishable by fine, for failure to comply with the obligations set out in paragraphs 1, 4, 5, 6, 7 and 8 of Article 12, as well as those set out in paragraphs 1 and 2 of Article 13. Non-compliance constitutes an offence (contra-ordenação) that is subject to the application of fines ranging from EUR 2,500 to EUR 44,000. In addition, fines, suspension, or closure of the activity and exclusion from entitlement to any public benefits or subsidies may also be imposed.

3.4 Audit content

3.4.1 Content

To carry out an audit properly, it is essential to implement certain procedures, in a sequential and correct manner, with the aim of optimising their execution. For this, an audit should comprise the following phases: preparation of the intervention, intervention on site and data processing. The intervention on site is the phase that requires more time and resources. It starts with a walking-through audit to recognise/map the site and processes and plan the overall field work. During the onsite intervention, the auditor installs energy analysers, energy monitors, and sensors, take spot measurements, ask questions, make interviews if necessary, etc.

The last phase consists of processing and analysing all collected data and preparing the audit report which should include the identified opportunities for rationalising consumption, including technical and economic analysis. The report needs to provide at least 3 energy indicators: Energy Intensity, Carbon Intensity and Specific Energy Consumption. In practice, the audit should:

- Quantify the different energy uses and try to disaggregate per main section and end-use;
- Characterize the load profiles for the main end-users/ systems;

- Check up of the energy system network and existing sensors and controls; inspect losses of compressed air;
- Establish a procedure for installing or improving energy management systems.

SGCIE: There is no protocol established, nor quality control of the data collected; certified auditors are provided with a list of general guidelines to carry out the audits. No assurance of the robustness of reporting data, as there are no requirements for granularity of data, detail and accuracy of analysis, etc. A cost-benefit analysis based on the payback is usually provided.

SCE: There is a specific methodology that needs to be followed to issue the certificates, but for the field work, the auditors have the freedom to use the methods they want.

Nevertheless, without defining specific standards and methods, each framework provides a list of minimum requirements:

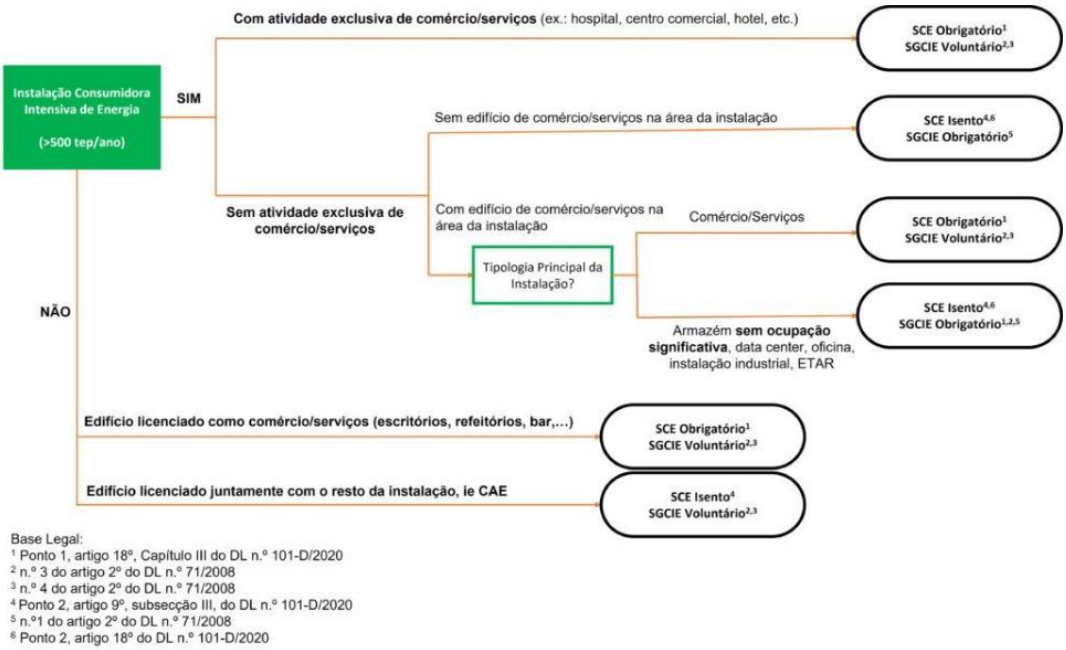
- Parameter to be quantified
- Characterized equipment
- Checked equipment
- Details on energy transformation and costs
- Load diagrams
- Evaluation of efficiency and specific energy consumption
- Identification of anomalies and opportunities for energy savings, etc.

Do auditors make surveys, and interviews during the audit?

Carrying out structured surveys or interviews during the audit is not foreseen in the legislation but there can be informal interviews in case the auditor finds them useful.

Large buildings can have the requirement of an EPC and an energy audit (if it belongs to a non-SME company). However, during the validity period of the certificate, no audits are required.

Under the terms of nº3 of article 2 of Decree-Law 71/2008, buildings included within the scope of the EPC (SCE) are exempt from the SGCIE, except when integrated within the area of an Energy Intensive Installation. The next Figure summarises the legal obligations of the SCE together with the SGCIE, underlining that the main typology is understood to be the predominant activity carried out at the installation



3.4.2 Non-energy benefits

Besides the avoided CO_2 emissions, there are no other non-energy benefits being evaluated in Portugal.

3.4.3 Quality and presentation

Quality of an audit

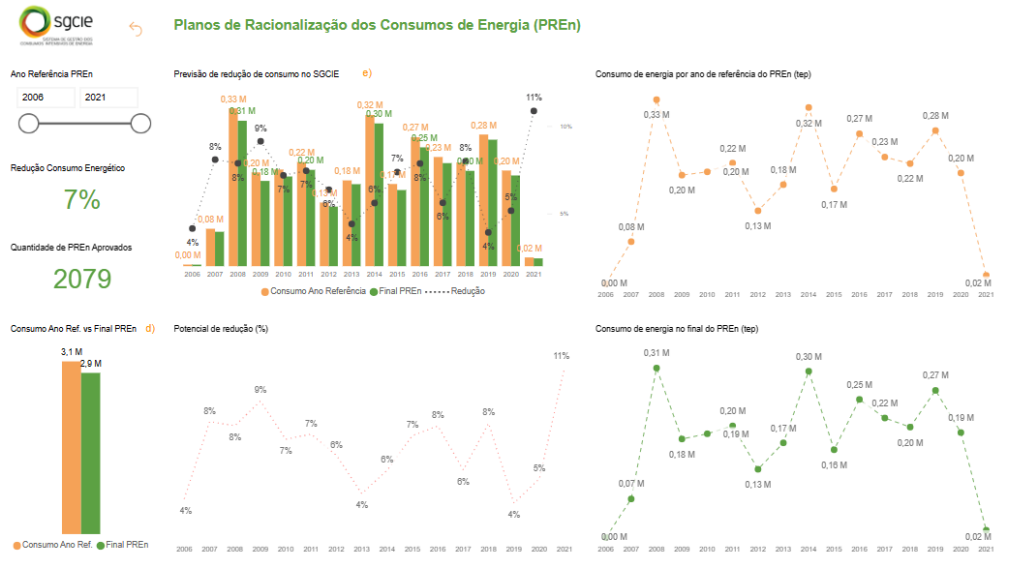
Some auditors provide good audits, but their prices are higher. Companies that recognize the value of the audits are willing to pay more because they understand the advantage of better audit results. However, there are still companies that do not see the added value of a good and detailed audit and therefore their concern is just about complying with the legal framework. In his role of supervising authority, DGEG tries to evaluate the quality of the audits being carried out, asking for additional details when they find audit reports with low quality. This way they also try to motivate the auditors to provide good audits.

Regarding the Buildings Certification, since it is mandatory to have the Certificate to sell or rent the building, the situation is similar regarding the quality and the drivers of the audits.

Usual savings

Regarding the audits in Energy Intensive Companies, following the SGCIE framework, as it can be seen in the next Figure, typical energy savings vary from

year to year and, comparing the baseline with the measures implemented, we can say there is an average savings of 6-8%.



Source: https://sgcie.pt/estatisticas/

How are the results of an energy audit presented to enterprises?

The results of the audit are presented to enterprises through bilateral meetings, involving the auditor, the energy manager of the company and the environmental department. The management staff is usually involved later, after the facilities operators analyse the audit results. Facilities operators have then to submit it through a website (http://sgcie.publico.adene.pt/) to the Directorate General of Energy and Geology (DGEG). Upon DGEG's approval (which is the competent authority that supervises and inspects SGCIE operation) the PREn becomes a Rationalization Agreement for Energy Consumption (ARCE) and from now, biennial execution and progress reports will have to be elaborated by the auditors and submitted in the portal.

3.5 Audit market

Cost and time of an audit

Depends on the size and structure of the company. On average, for a large industrial company, an audit takes around two months and costs around 5.000€-10.000€. On-site measurements and field work to collect information typically takes 4 weeks.

For buildings, the audits can take less time for the fieldwork, but depends on the dimension of the building. Regarding the costs, there are two different costs to get a Certificate: the registry at the ADENE platform (that is established by legislation

according to the area/typology and can vary from 28€ to 65€) and the cost of the audit itself, which can range from 250 € to thousands of euros, depending on how complex and how detailed it is.

Who are the market actors?

These are mainly SMEs and micro companies with less than 5 employees. Many companies are one-man auditors.

Companies

There are in total 1,328,547 companies in Portugal, of which 13,603 are large companies (Energy Intensive Companies, with yearly consumption >500toe) and 1,314,944 are SMEs.

SMEs are not obliged to carry out audits. However, to apply to some funding schemes and subsidies, an audit may be required.

Selecting auditors

There is a pool of accredited auditors (213 auditors by now) from which enterprises must select the auditors. There are several auditors and companies, who have a lot of credibility in the market and those are very demanded. However, the accreditation is given to individuals, not companies. Being a small country, word of mouth is a powerful marketing instrument that many enterprises consider when selecting auditors. Of course, since the system is already implemented for some years now, auditors already have their track record, and some auditors are well recognized and requested.

Energy management system, culture

The existence and the quality of an energy management system mainly depend on the share of energy costs in the overall balance of the budget. Industrial companies are more likely to care about energy management systems because they have a better understanding of energy costs and technical issues. Nevertheless, the concern about energy management has been increasing transversally.

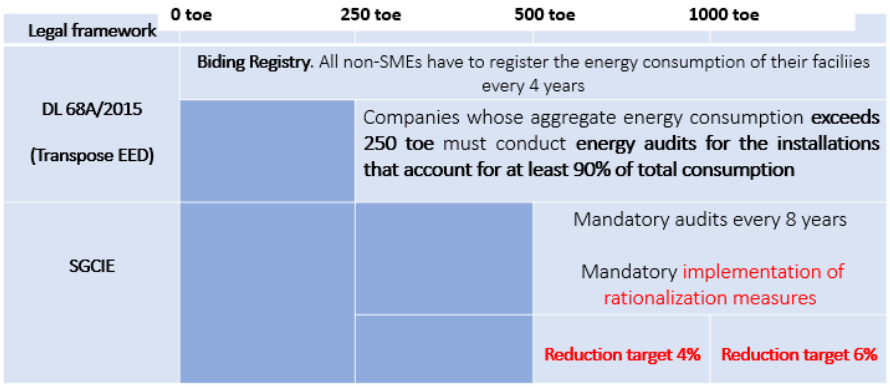
Decision-making process on the implementation of recommended measures

The rationality for the implementation of the identified measures is usually based on the payback time. Measures with payback shorter than 2-3 years are usually implemented without delay. Another motivation is the availability of incentives. Having a Rationalization Plan (ARCE) offers facility operators excise duties exemption (ISP) on oil and energy products (coal, oil coke, fuel oil and oil gases) and the possibility to apply for incentives on energy audit costs and on investments in energy management and monitoring equipment.

Exemptions in excise duties are foreseen on the national budget for fuels used either by consumers committed to the reduction of CO_2 emissions in the framework of the European Union Emissions Trading Scheme (EU ETS) or by consumers that have a Rationalization Agreement for Energy Consumption.

Obligation to implement suggested energy efficiency measures

SGCIE/ DL 68A As it can be seen below, DL68A/2015 is more permissive than the SGCIE because it does not require the implementation of rationalisation measures, nor does it have any control over such implementation, unlike the SGCIE that establishes reduction targets to be reached before the next audit. Moreover, SGCI is applicable to individual unit sites and not to aggregated consumptions of a company.



What do market actors think about energy audits? (useful / just another tax?)

It depends on the companies: some think it is just another paper and therefore they are not willing to pay for a good audit, which is more expensive.

Impact of energy crisis

With the energy crisis, and the increasing prices of energy, the number of requests for audits has increased and the auditors do not have hands to reply to the demand.

3.6 Calculation methodologies, tools, templates

There is no official/required software for energy audits but there is an official software tool for issuing Energy Performance Certificates of buildings. The regulation for large buildings is quite complex and requires a dynamic simulation to be carried out.

The good auditors are themselves well organised and have developed their own tools, which are not publicly available.

3.7 Best practice examples

COMBI online tool

The COMBI project[37] aimed at quantifying the multiple non-energy benefits of energy efficiency in the EU-28 by gathering existing approaches and developing modelling methods. All data can be analysed via a graphic online-visualisation tool with data export function.

Publications on NEBs indicators

- Transposing the Requirements of the Energy Efficiency Directive on Mandatory Energy Audits for Large Companies: A Policy-Cycle-based review of the National Implementation in the EU-28 Member States – 2019 Energy Policy
  The aim of the paper is to analyze differences and similarities in the national requirements and to derive good practice for policy makers. It structures the implementation process according to the theoretical concept of Policy Cycle Analysis and apply it as a heuristic from a multi-level governance perspective.

- Untapping multiple benefits: hidden values in environmental and building policies – 2020 JRC
  This study provides guidance to policy and decision-makers in developing a methodology for the inclusion of multiple benefits in a cost/benefit assessment of energy efficiency policy. It is envisaged that providing a macroeconomic understanding of the wider benefits of energy efficiency in buildings will encourage policy-makers and investors to develop and quantify the benefits of more effective energy efficiency policies and programmes and drive higher levels of renovation, thus supporting the EU's Renovation Wave.

- A methodology for the assessment of multiple benefits of industrial energy efficiency measures– 2020 Springer Nature Journal
  The aim of the paper is to close the gap between a comprehensive and standardized methodology to assess the multiple benefits of energy efficiency measures in an industrial context and the omitted one with the introduction of a three-phase standard methodology, applicable to a wide range of industrial processes and energy efficiency measures. Results have shown that the consideration of monetizable multiple benefits may reduce the payback time of energy efficiency measures by up to 40–85%.

Questionnaire

In the MBenefits project (see also chapter **Hiba! A hivatkozási forrás nem t alálható.**) a questionnaire has been developed that can be used to collect information about audits and non-energy benefits. The M-Benefits project (valuing and communicating the Multiple Benefits of Energy Efficiency) was aimed at

[37] https://combi-project.eu/tool/

creating a framework for the inclusion of the multiple benefits of energy efficiency in investment assessment and decision-making of companies and relevant stakeholders. It has been achieved through the combination of research activities and the development of a robust methodology to assess and quantify non-energy benefits and their effect on the financial investment evaluation. It was also targeted to train and build the capacity of energy efficiency experts to be able to evaluate the multiple benefits (MB) of industrial and building/tertiary sector focused energy efficiency projects (i.e., industrial production sites, administrative and commercial buildings), not only the energy savings-related benefits.

Finally, the SGCIE framework has been applied successfully among the Energy Intensive Companies in Portugal. The information is collected by ADENE in a specific portal[38] and the aggregated results can be seen here (unfortunately, it is not available in English).

This portal is a collaborative platform where companies can find information and support related to the existing regulation for industrial companies. This online platform provides the framework conditions to those installations that are Intensive Energy Consumers which, in the immediately preceding calendar year, had an energy consumption equal to or greater than 500 tonnes of oil equivalent (500 toe/year), except for cogeneration installations that are legally autonomous from the respective energy consumers. It is possible to register intensive energy consuming installations, recognising and search for qualified technicians to perform Energy Audits and draw up Energy Consumption Rationalisation Plans (PREn) and the respective Implementation and Progress Reports (REP), as well as the submission and validation of all these types of documents which have to be delivered to the Directorate General of Energy in the scope of the SGCIE regulation.

The Portal aims to facilitate the implementation of the legislation and at the same time, provides statistical information and synthesis reports that are useful for policy makers and can motivate companies to carry out energy efficiency improvements.

3.8 Summary

3.8.1 Strengths

Non-SME companies that have an approved Rationalisation Plan or a valid SCE certificate are exempt from submitting a new audit until the documents expire. However, the registration obligations remain.

[38] https://sgcie.pt/estatisticas/

The installations or fleets that have a Rationalisation Plan approved within the scope of the SGCIE or RGCE-ST, and which are still in force, are exempt from submitting a new audit until the end of the validity period of the respective Plans.

Buildings with a valid SCE certificate are exempt from submitting a new audit until its expiry date.

In any of the circumstances, the registration obligations set out in article 13 of Decree-Law no. 68-A/2015 remains in force.

3.8.2 Weaknesses

For each different regulation (SGCIE; DL 68A, RCE, RGCTE) the company needs to submit, online, the collected Data in different portals which do not communicate (no interoperability exists) to each other. This represents a huge burden for large companies, especially when they have to provide information for buildings, industrial sites and transportation fleets. Besides the energy audits, they need to have one person, or more, allocated to this task for one or two months, just to fill in the Portals with data.

3.8.3 Barriers to uptake, main problems

The main barriers to the uptake of energy audits are mainly related to two factors:

- The understanding by decision-makers of the impacts of energy costs;
- The complexity of the regulations.

Unlike the SCE, the SGCIE (former RGCE) framework is simple to apply and does not require the energy auditors to have specific knowledge of dynamic simulation. In addition, the stakeholders in the industry are better prepared to understand the importance of carrying out energy audits than building operators or managers.

3.8.4 Position of non-energy benefits

NEBs are not part of the requirements for the audits associated with national legislation. Only energy and energy-related parameters (e.g. GHG emissions, specific consumption, ...) are required in the audits.

3.9 References

https://clean-energy-islands.ec.europa.eu/countries/portugal/legal/energy-efficiency-policies-ee/energy-efficiency-measure-management-system

https://cms.law/en/int/expert-guides/cms-expert-guide-to-energy-audit-requirements-and-standards

Energy audit requirements in Portugal | CMS Expert Guides

https://cms.law/en/int/expert-guides/cms-expert-guide-to-energy-audit-requirements-and-standards/portugal

https://sgcie.pt/

https://www.dgeg.gov.pt/en/dgeg/mission-domains/

4 Spain

4.1 Legislative requirements for enterprise energy audits

The most important acts are as follows:

- Real Decreto 56/2016: it sets the requirements for mandatory audit, period, minimum information on the audit, who can perform audits contents for energy auditor's training, etc[39].
- Real Decreto 390/2021: It is a template to communicate the results of the audit.[40]
- The Spanish government is working on adapting the Real Decreto 56/2016 to the new directive on energy efficiency.[41]
- Ley 18/2014, Art. 80 and 82. The document sets the sanctions for the non-compliance of energy audits.[42]

4.2 Standards, norms applied in the energy auditing practice.

In Spain the "UNE-EN 16247: standards to perform energy audits" is applied.

4.3 Auditing system and process

4.3.1 Executive bodies and their roles

The responsible organisations are as follows:

- Regional governments are responsible for the control of the execution of mandatory energy audits.
- Auditing companies and auditors are the ones in charge of doing the energy audit and propose energy measures.
- The audited company is the one in charge of taking the initiative of performing the energy audit every 4 years (maximum) and the one who decides which energy measures take place in the end.

[39] https://www.boe.es/buscar/doc.php?id=BOE-A-2016-1460
[40] https://www.boe.es/buscar/doc.php?id=BOE-A-2021-9176
[41] Directive on Energy Efficiency (DEE)
[42] https://www.boe.es/buscar/act.php?id=BOE-A-2014-10517

4.3.2 Auditors' network

According to RD 56/2016, auditors can be people with a degree related to energy or with accredited theoretical and practical knowledge about energy or qualified technicians who work on the enterprise but have no direct relation with the audited activities.

There are no costs or fees for being an auditor, besides energy related studies (e.g. Engineering Bachelor and Master). There is no official registry of energy auditors.

4.3.3 Reporting, audit database

Energy audits are mandatory for companies with over 250 employees and/or >50 M€ of business volume and >43 M€ of general balance. An energy audit has to be done every 4 years.

The audit needs to cover at least 85% of the total energy consumption of the company on national territory.

Real Decreto 390/2021 includes a template with a summary of the information about electric energy, thermal energy, and transport demand and estimated savings, CO_2 emissions avoided and investment from the proposed measures.

The company sends the information or upload them in the website of the regional governments; they report it to the RAAE (Administrative Register of Energy Audits managed by Ministry MINCOTUR[43])

Nowadays, there is a public database[44] with all the names of the companies who have reported a mandatory energy audit and the date. In the future, the aggregated data provided will be showed and analyzed on a public document created by MINCOTUR. At regional level, e.g. Castilla y León, the available data are: number of energy audits done, date, energy consumption, energy savings, emissions, investment, payback time, etc. Most regions have no publicly available data.

4.3.4 Compliance and control, sanctions

The regional governments are the bodies responsible for the implementation of mandatory energy audits.

The sanctions are the following according to Law 18/2014, Art. 80 and 82:

[43] MINCOTUR, Ministry of Industry, Commerce and Tourism
[44] https://energia.serviciosmin.gob.es/RAAE/

Type	Description	Fine
Very severe	No energy audit, false doc., etc.	10,001 – 60,000 €
Severe	Lack of content, no meters installed for (heat/cold/DWH), no official qualified auditor	1,001 – 10,000 €
Mild	Results not communicated, others	300 – 1,000 €

Depending on the infraction, the sanctioned body will be the auditor or the audited company.

There is no available information about the control process.

4.4 Audit content

4.4.1 Content

The energy audit must include updated data, an analysis of energy consumption, an investment evaluation and they must reflect the calculations in detail and validated. The mandatory information is presented in Annex 1.

4.4.2 Non-energy benefits

The only mandatory NEB is the estimated amount of CO_2 emissions avoided. Non energy benefits are not mandatory on energy audits (except CO_2 emissions avoided), so it is up to the criteria of the auditor to include them.

4.4.3 Quality and presentation

There is no available official data about the quality of the audits carried out so far. The savings change significantly depending on the company and its sector.

Energy audits are presented in a written report and usually it is presented in a meeting with the energy managers or technicians of the company.

4.5 Audit market

The cost and time of energy audit can be very different from 3,000-50,000 EUR, 2-6 months (no available official data). The market actors are the audited

companies, the auditors who can be external or from the company. It is not mandatory to implement the recommended measures of the energy audit. Therefore, other companies that provide these measures can be involved. Examples: installer companies of new machinery, motors and steam boilers. The actors are different for residential buildings and for companies: different Ministries and different people in Regional Governments.

Energy audits are mandatory for companies with over 250 employees and/or >50 M€ of business volume and >43 M€ of general balance. An energy audit has to be done every 4 years. The audit needs to cover at least 85% of the total energy consumption of the company on national territory.

The energy audits are not mandatory for public buildings; most public buildings should show the energy label of the energy performance building certification.

There are 4977 large companies in Spain. SMEs are not subject to mandatory audits.

If the company has a certified energy management system by an independent body following the corresponding European or international legislation (like the ISO 50001), the company is exempt from doing these energy audits. There is no obligation to implement the measures recommended on the energy audits.

Many companies think that energy audits are not useful, just and administrative obligation. The current energy crisis has influenced the companies because energy costs have increased considerably. This situation is encouraging the implementation of energy audits and measures in some companies.

4.6 Calculation methodologies, tools, templates

There are no official methodologies, tools or templates. But some organisations have developed guides and templates to facilitate the process.

The auditors do not make surveys, but they visit the industry and take energy consumption measures, general data of the industry like product units/month, electricity bills, temperatures, surfaces, etc.

Each professional/company use professional software and Excel files. For example, lighting or motors simulating software are commonly used. But for the industrial processes, only few companies make their own tools. No official software to develop energy audits in companies.

There are no official questionnaires/templates to collect results to implement an audit.

Many guides have been developed, some examples:

- Methodology guide for energy audits[45]
- Guide for energy audits on the hotel sector[46]
- Guide for energy audits on offices[47]
- Guide for energy audits on shopping malls[48]
- Methodology for the elaboration of energy audits on industries[49]
- Procedure for energy audits on the industrial sector[50]

4.7 Best practice examples

The following two projects can be considered as best practice:

- Audit 2 measure project addresses three main barriers which may block the adoption of energy saving measures in the industrial sector, including lack of information (about the costs and benefits; energy contracts; the potential impact on the business); behavioural inertia (due to lack of interest or commitment; imperfect evaluation criteria); and economic discouragement (low capital availability); intervention-related risks by engaging stakeholders through a holistic approach, which focuses on clarifying the auditing process and selecting success cases as replicable examples.[51]

- The Steam Up project[52] is interesting with a qualitative assessment, but it does not quantify NEBs. Steam Up aims to assess the substantial and easy to reach energy-saving potential of steam systems in heavy industries, to support the EU objectives for energy efficiency. This increases energy efficiency of steam and contributes to CO_2 reduction by saving 55.6 GWh per year in the heavy industry throughout Europe.

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[45] Methodology guide: https://icaen.gencat.cat/web/.content/10_ICAEN/17_publicacions_informes/04_coleccio_QuadernPractic/quadern_practic/arxius/07_auditories_energetiques.pdf

[46] Guide energy audits - hotels: https://www.miteco.gob.es/es/cambio-climatico/planes-y-estrategias/GuiaAuditoriasEnergeticasHoteles_CAM_tcm30-70382.pdf

[47] Guide energy audits – offices: http://www.madrid.org/bvirtual/BVCM015006.pdf

[48] Guide energy audits - shopping centres: https://www.fenercom.com/wp-content/uploads/2010/11/Guia-de-Auditorias-Energeticas-en-Centros-Comerciales-fenercom-2010.pdf

[49] Guide energy audits – industries: https://www.agenciaandaluzadelaenergia.es/es/biblioteca/metodologia-para-la-elaboracion-de-auditorias-energeticas-en-la-industria

[50] Guide energy audits industries 2: https://www.fenercom.com/wp-content/uploads/2009/05/Procedimiento-de-Auditorias-Energeticas-en-el-Sector-Industrial-de-la-Comunidad-de-Madrid-fenercom-2019.pdf

2[51] Audit to measure Project: https://escansa.es/en/audit-to-measure-leading-business-towards-climate-neutrality-by-speeding-up-the-uptake-of-energy-efficiency-measures-from-the-energy-audits/

[52] https://steam-up.eu/en

4.8 Summary

4.8.1 Strengths

The following positive elements can be underlined:

- The national registry of the Ministry MINTECO,
- An energy audit should be done each 4 years for non SMES companies since 2016. When a company carries out a new energy audit, it should include the implemented energy efficiency measures of the previous four years. The energy savings and other economic data of these previous measures has to be included in the audit and in the national registry of the MINTECO.

4.8.2 Weaknesses

The following weaknesses can be underlined:

- Energy audits have not been a priority issue. Now with high energy costs the companies are aware (1.125 energy audits per month are registered from October 2022 to February 2023).
- Measures of energy efficiency and renewable energy sources included in energy audits or identified by the company. Other priorities of investments, high investment costs; lack of financing. With the change of energy costs some measures will be implemented
- There is a mistrust on the estimated savings.

4.8.3 Non-energy benefits

Non-energy benefits are usually not taken into account for the decision-making process, unless there is a quantified reduction (like reduction of the CO_2 penalties, reduction of the costs on insurance, reduction of sick leave, etc.)

5 Austria

5.1 Legislative requirements for enterprise energy audits

The main law for energy audits is the Energy Efficiency Act (BGBl 72/2014)[53]. It came into force in 2014 and was valid until 2020. From 2021, there was no obligation for an energy audit as there was no legislation existing.

The review process for the draft for the new Energy Efficiency Act was underway at the turn of the year 2022/23. It can be assumed that the new Efficiency Act will make audits mandatory again starting with September 2023. The new law only contains the provisions of the EED 2018, but none of the current draft.

The specifications for the audits and the associated provisions were made in accordance with the efficiency guideline.

5.2 Standards, norms applied in the energy auditing practice

While the previous energy efficiency Act still refers to EN 16247-1, this is no longer the case in the future act.

If the energy audit is implemented within the framework of an energy or environmental management system, it must comply with a recognised management system like ISO 50001 or the EMAS Regulation (EC) 1221/2009, OJ L 342, 22.12.2009, p. 1.i.. Using these management systems, the same requirements as for a regular energy audit must still be met.

5.3 Auditing system and process

5.3.1 Executive bodies and their roles

With the Energy Efficiency Act, a control authority (monitoring body) was created, which is responsible for monitoring the implementation of the audits and / or the energy management systems, the certification of the auditors as well as various requirements for implementation in Austria as well as the evaluation.

[53] Federal Act on Increasing Energy Efficiency at Companies and the Federal Government (Federal Energy Efficiency Act - EEffG); BGBl. I Nr. 72/2014 https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20008914

According the draft or the new legislation, the authority role will be located at the electricity market regulator (e-control).

5.3.2 Auditors' network

In order to become an energy auditor in Austria, one must present professional qualification. These requirements are partly based on education and partly on practical experience. Depending on the qualification, one can become an auditor for buildings, processes and/or transport.

The training part of the qualification can either be executed within the framework of school or university education or in some courses. The practical experience must include activities comparable to those of an auditor.

The licence is provided upon application with proof of qualification. So far, the qualification has been awarded for an unlimited period. With the current draft of the EEffG, it is envisaged that ongoing proof of practice must be provided in order to retain the certification. Thus, in the future, the qualification may expire.

No costs are associated with the application and the maintenance of the qualification.

The competent body for certification is the Monitoring Body. This is also where the public register is located, in which all auditors and their approved areas are listed including contact information.

There are 614 auditors in total, of which

- 526 are for buildings
- 391 for processes
- 154 for transports

are responsible. These figures also include auditors who act as internal auditors within companies which prefer energy management systems.

5.3.3 Reporting, audit database

Energy audits are mandatory for companies with over 250 employees or >50 M€ of business volume and >43 M€ of general balance, whereby the audit should not be older than 4 years.

If one of the three sectors (building, process, mobility) comprises more than 10% of the total energy consumption, the audit must be carried out for this sector.

The situation is a little unclear if the company has more than one location. Although the entire consumption has to be recorded, only a representative analysis of selected locations is to be carried out.

The completion of the current audit report must be reported, whereby only a short report of the audit has to be uploaded to the monitoring body. In addition, selected data such as the name of the auditor, operating data and energy consumption data must be entered in an online input Screen.

There is a public database with all the names of the companies who have reported an energy audit or an Energy management system between 2015 and 2021.

5.3.4 Compliance and control, sanctions

The monitoring body ("Monitoringstelle") is responsible for controlling the obligation of the audits as well as their quality.

The monitoring body carries out random checks to ensure that the formal requirements for the preparation of the audits are complied with. For this purpose, the monitoring body requests the long version of the audit from the companies.

According to information, 4% of the audits are checked.

If a company does not prepare an audit despite its obligation, a penalty is foreseen.

5.4 Audit content

5.4.1 Content

An energy audit must be prepared for those sectors (building, process, mobility) whose share of total energy consumption is greater than 10%.

The Energy Efficiency Act regulates what must be included in an audit. These requirements are in § 11 as well as in the Annex of the Act.

The monitoring body recommends a template for the structure of the audit report. However, the use of this template is not binding.

The structure of the template is presented in Annex 2.

5.4.2 Quality and presentation

The monitoring body specified the form of the audit report.

In the draft version of the new EEffG is said:

§Section 11(3): E-Control shall issue a decree laying down more detailed provisions on the format, structure and layout of the standardised summary reports.

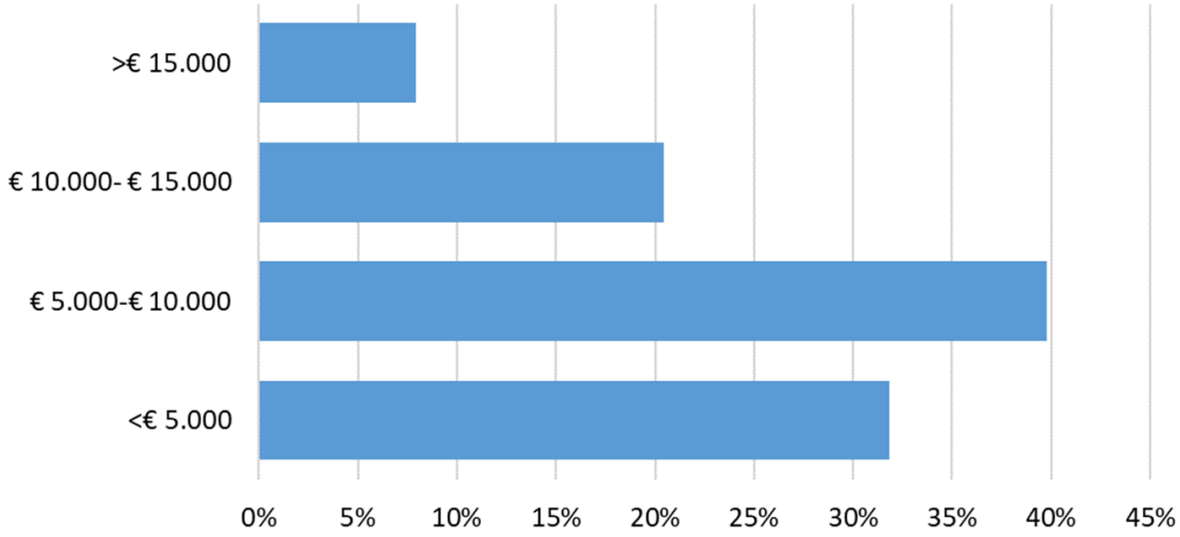
And the moment it is still unknow which detailed requirements will be demanded of the audit in the future with regard to format, layout and content.

The audit reports are only checked by the monitoring body. There is no provision for the results or the audit itself to be publicly viewable.

The draft version of the law sets that results of the energy audit can also be made available to the National Statistics. In what form this will take place is not known yet.

5.5 Audit market

The costs for an energy audit can be seen in the graph below.



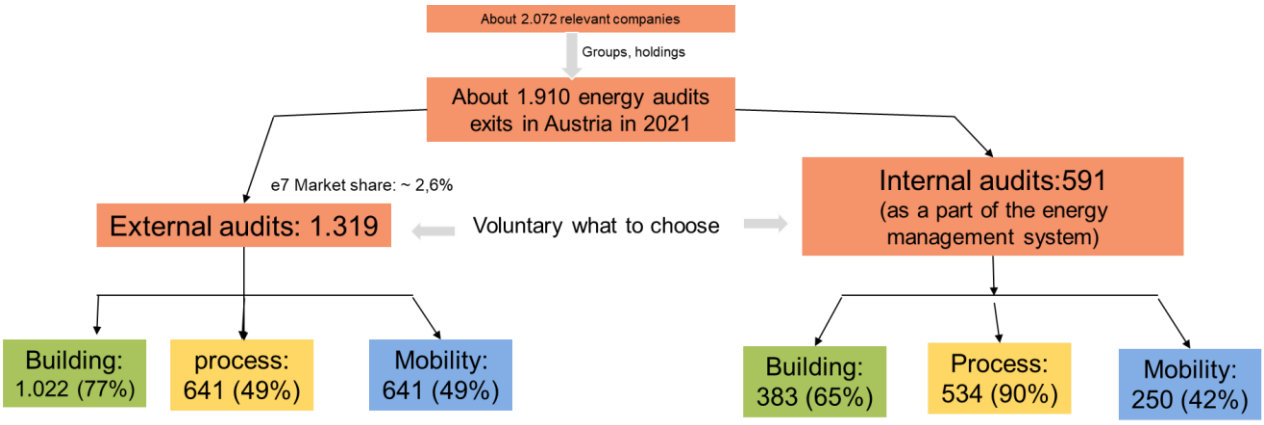
Distribution of costs for an audit in Austria (Source:Markbeobachtung_Report_2017_1.pdf; AEA)

It can be assumed that with the new regulations there will be more effort for the layout, which will also increase the costs.

Until now, there is no obligation for the public sector (Public-law companies) to make an audit or to establish an energy management system.

With the new legal provisions, the obligation also applies to public law companies.

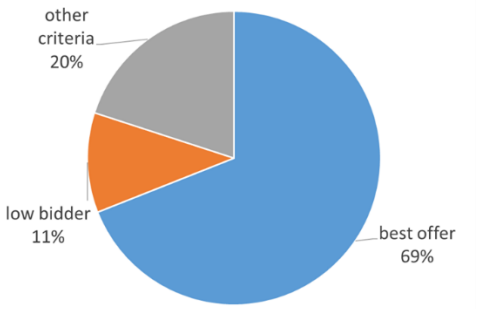
The numbers of large companies can be seen below. Until 2020 there were about 2000 companies that fall under the provisions of the Energy Efficiency Act. The exact number of relevant farms is not known. With the new regulations, about 200 companies will be added.



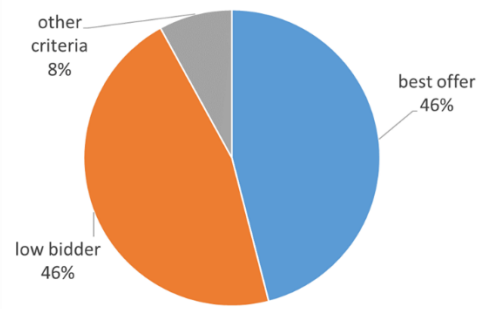
SMEs have no obligation to conduct an audit.

When companies are asked how they select the auditor, 69% say they select the best offer. If you ask auditors, on the other hand, they say that the best offer counts for only 46%. On the other hand, companies say that only in 11% of cases the lowest bidder was selected. In contrast, the energy auditors assume that this is the case in 46% of the awards. The following figures present how companies choose the auditor.

How the companies see it:



How the auditors see it:



The situation of e7: primary previous contacts to the companies and direct enquiries (with price competition)

5.6 Calculation methodologies, tools, templates

The economic efficiency has to be calculated by using a dynamic economic efficiency calculation. If this is not the case, the reason for this must be justified.

There is no requirement regarding the use of specific tools for determining the cost-effectiveness of measures.

There is only a template for the short version and the long version of the audit report. However, the use of these templates is not mandatory.

e7 has two tools that it uses as standard when preparing energy audits.

YESSA – Software

The YESSA software – made by e7 - is an innovative and web-based energy audit process management tool. It supports energy auditors in their core activity and helps to optimally integrate the energy audit into adjacent company processes of the client (documentation and management of YESSA supports the auditing and documentation of companies, buildings and facilities, the identification of optimisation potentials and the creation of automated reports. With digital on-site recording via tablet or smartphone, the software reduces the effort required for documentation and administration of data. With suitable analysis tools, optimisation potential can be quickly identified and suggestions for improvement formulated.

A dedicated app supports on-site data collection. Depending on the specifications, various templates can be integrated for the report. e7 provides the YESSA tool in the form of licences.

e7 Power load analyser

With the load curve analysis tool developed by e7, it is possible to analyse electricity consumption with little effort and in a short time. For this purpose, the data of the trend series, which represents the electricity consumption at intervals of 15 minutes, is graphically processed in more than 60 images. The images represent specific questions about electricity demand. The interpretation of the images then makes it possible to find the potential savings. In practice, 5 to 10% savings can be found.

5.7 Summary

5.7.1 Strengths

The energy audits and the Energy Efficiency Act are an important instrument to recognize the efficiency potential for many companies. As a result, energy officers have often been appointed, an energy management system was introduced at companies after the first energy audit and awareness of energy efficiency has generally increased.

The fact that a new audit is to be carried out every four years is to be welcomed.

The high number of energy management systems which were introduced.

The public register of energy auditors and their fields of expertise.

Companies are gaining experience with the audits.

5.7.2 Weaknesses

- No uniform quality standards and procedures for audits leads to price pressure for providers.
- Often misconceptions about short-term efficiency opportunities by the instrument of audits in the segment processes by policy makers.
- Not all obligated companies produce an audit because there were few official ways to recognize this companies.
- Low willingness of stakeholders to support this important tool (No active promotion of this useful tool and also no information on how to get added value from audits).
- The lack of commitment from the public sector to also conduct audits.
- Lack of evaluations of the results and lessons learned so far. Lack of best practice examples as well as empirical data on how to get a good audit.
- Transportation is mostly just statistics of catenary and e-mobolity is cited as an efficiency measure. This is simply too little for this large consumption segment.

6 Bulgaria

6.1 Legislative requirements for enterprise energy audits

The main law for energy audits is the Energy Efficiency Act since 2015y./last edition 12.03.2021y [54].

There is obligated exempted persons under Energy Efficiency Act to make Energy Audit (EA). All obligated under Energy Efficiency Act enterprises, applying energy or environmental management system subject to certification by an independent body compliant with European and International standards, are exempted from mandatory Energy Audits, in case that energy audit is included in the applied management system

The specifications for the audits and the associated provisions were made in accordance with the efficiency guideline.

6.2 Standards, norms applied in the energy auditing practice

The main norm that determines the basic principles of auditing of enterprises is laid down in RD-04-05 of September 8, 2016 - for energy consumption indicators of industrial systems, conditions and procedures for conducting energy audits in industrial systems[55].

The European audit standards (BDS EN 16247 series parts 1 to 5, BDS EN ISO 14001, BDS EN ISO 16001, BDS EN ISO 50001) are translated and widely used in Bulgaria. For buildings has prescribed calculation method based BDS EN ISO 52000-1, BDS EN ISO 52003-1, BDS EN ISO 52010-1, BDS EN ISO 52016-1 and BDS EN ISO 52018-1.

[54] https://lex.bg/bg/laws/ldoc/2136500695

[55] https://www.me.government.bg/bg/library/naredba-e-rd-04-05-8-09-2016-g-za-opredelyane-na-pokazatelite-za-razhod-na-energiya-energiinite-harakteristiki-na-predpriyatiya-promishleni-sistemi-i-sistemi-za-vanshno-izkustveno-osvetlenie-kakto-i-za-opredelyane-na-usloviyata-i-reda-za-izvarshvane-na-obsledv-592-c78-m1517-3.html

6.3 Auditing system and process

6.3.1 Executive bodies and their roles

With the Energy Efficiency Act, a control authority (monitoring body) was created, which is responsible for monitoring the implementation of the audits and / or the energy management systems, the certification of the auditors and their registration in a public register as well as various requirements for implementation in Bulgaria as well as the evaluation.

Energy audits are controlled by Sustainable Energy Development Agency (SEDA) with main responsibilities as follows:

- Documentation control: Check of the information in Energy Audit Summary; Check of completeness of set the required documents;
- Data input in National Information Energy Efficiency System.

The ordinance requirements for EA stages with main stages and activities are:

- Preparatory stage,
- Research and analysis,
- Development of energy efficiency measures,
- Final stage.

6.3.2 Auditors' network

In order to become an energy auditor in Bulgaria, one must present professional qualification. These requirements are partly based on education and partly on practical experience. Depending on the qualification, you can become an auditor for buildings, processes and/or industry.

The training part of the qualification can either be done within the framework of university education. The practical experience must include activities comparable to those of an auditor.

The award is made upon application with proof of qualification. So far, the qualification has been awarded for an unlimited period.

Applying for and maintaining the qualification costs around 1500 euros. The companies consist of three experts with mandatory qualifications – a construction engineer, an HVAC engineer and an electrical engineer. In order to be entered in a public register, the company must have a minimum set of mandatory equipment, which can reach up to 15,000 euros.

The competent body for certification is the Monitoring Body. This is also where the public official register is located, in which all auditors and their approved areas are listed.

There are 924 auditors in total, of which

- 768 are for buildings
- 156 for processes

are responsible. These figures also include auditors who act as internal auditors within the framework of an energy management system.

6.3.3 Reporting, audit database

Mandatory energy audits are applied to:

- Manufacturing enterprises that are not SMEs according to the meaning of Art. 3 of Small and Medium Enterprises Act in Bulgaria;
- Enterprises which provide services and are not SMEs according to the meaning of Art. 3 of SMEs Act in Bulgaria - with over 250 employees or >50 M€ of business volume and >43 M€ of general balance;
- Industrial systems whose annual energy consumption is over 3000 MWh;
- External lighting systems, located in villages with a population of over 20,000 inhabitants.

The audit should not be older than 4 years.

The completion of the current audit report must be reported. Within 14 days from acceptance of the energy audit report the owner of the enterprise is required to submit to SEDA:

- Certified copy of the Summary – printed and electronic form;
- Certified copy of the protocol of acceptance;
- Statement by the auditing company.

6.3.4 Compliance and control, sanctions

The monitoring body (SEDA) is responsible for controlling the obligation of the audits as well as their quality.

The monitoring body carries out random checks to ensure that the formal requirements for the preparation of the audits are complied with. For this purpose, the monitoring body requests the long version of the audit.

According to information, 4% of the audits are checked.

If a company does not prepare an audit despite its obligation, a penalty is foreseen.

6.4 Audit content

6.4.1 Content

The Energy Efficiency Act regulates what must be included in an audit. These requirements are in Norm RD-04-05 of September 8, 2016 - for energy consumption indicators of industrial systems, conditions and procedures for conducting energy audits in industrial systems.

The monitoring body recommends a template for the structure of the audit report. However, the use of this template is not binding (see Annex 3 for more details).

6.4.2 Non-energy benefits

Currently the only NEB that is included in the evaluation of the CO_2 emissions.

Non energy benefits are not mandatory on energy audits (except CO_2 emissions avoided), so it is up to the criteria of the auditor to include them.

For buildings the recommended retrofitting measures should comply with all normative requirements, including indoor air quality and comfort.

The environmental part is under different legislation. All of the topics concerning specific pollution and waste requirements are strictly observed by the Ministry of Environment and Water (MEW).

Depending on the specific needs of the enterprises additional things can be added. When the energy survey is needed for EU programs, they can also include:

- Increased productivity;
- Indoor climate condition;
- Level of energy efficiency in the building structures;
- Water treatment;
- Waste management.

6.4.3 Quality and presentation

The quality of the energy audits is generally very good, because the audit is made by the team of the company’s experts together with the specialist from the enterprise.

Every audit prescribes specific measures that are approved by the enterprise and thus there cannot be a significant difference from the expected and the actual result.

- Depending of the needs most of the enterprises are satisfied with the level of the audit. There are certain cases that the audit over evaluated the

energy saving or the expected specific consumption, but their number is very low.

The usual savings include:

- Monitoring and control systems,
- ESM for technology units and facilities,
- Replacement of technology equipment,
- ESM for steam and condensate systems,
- Elimination of leaks and insulation improvement,
- Measures for generating capacities,
- Fuel switching,
- Waste heat recovery,
- ESM on electric motors,
- ESM on transformers,
- ESM on lighting,
- Optimization of the building's energy consumption,
- Co-generation,
- RES.

Energy audits are presented in a written report and usually it is presented in a meeting with the manager and energy managers of the company.

Every audit must be submitted to SEDA up to 14 days after the completion from the company. Every enterprise is obliged to make energy audits must give yearly overview of the consumption and details of the implementation of the measures prescribed in the energy audit. Every audit company gives yearly information of the executed audits in the past year. All audits are checked in SEDA.

If the audit is made under specific financial scheme the audit is strictly checked for covering the national and the specific requirements.

There is an Energy Audit Database that can be characterised as follows:

- The database of every executed audit is maintained in SEDA register that is constantly updated;
- The data is public and can be accessed by official letter with the explanation of the specific needs for that information;
- There is information for the number of audits, prescribed ESM, expected energy savings, pay back periods and estimated CO_2 savings;
- There is no official information of the total number of energy audits because it covers not only obliged enterprises, but also different agricultural producers.

6.5 Audit market

There is an obligation for the public sector (Public-law companies) to make an audit or to establish an energy management system. There are approx. 754 large companies in Bulgaria. The first audits were uploaded in 2001, the quality checks started early 2005.

Audits are mandatory for large companies only. SMEs are not subject to mandatory energy audits.

The cost for an energy audit depends on the size of the company, its sites, and the complexity of its processes. It normally ranges between 6.000 and 8.000 euros but it can vary in a wide range.

The implementation of the proposed energy saving measures in the audits is not mandatory. Up to now, no market research on the level of implementation of the recommended energy audit measures has been carried out.

In case a company implements an energy management system that complies with EN ISO 50001, it does not need to carry out an energy audit. The cost of an EN ISO 50001 energy report is about one third of the cost of an energy audit, but it has to be carried out annually instead of every four years. In Bulgaria, many companies have decided to apply an energy management system.

Public buildings are obliged to carry out an energy efficiency implementation plan every four years, which can be considered as a simplified audit. Public organizations have to submit an energy performance report annually to the Authority about their buildings. They have awareness raising obligations as well.

Companies can select auditors from the official list of auditors published on the website of the SEDA.

The realization of energy saving measures listed in the audits about the industry are not mandatory in Bulgaria. But the realization of energy saving measures listed in the audits about the buildings are mandatory to be completed within four years after certification process.

6.6 Calculation methodologies, tools, templates

There are no official softwares approved by SEDA for energy surveys on industrial systems. All of the calculations are done by the energy survey team.

Specific softwares for different purposes can be used but it is up to the team. Every company has developed its own calculation tools depending of the type of the industry.

For evaluation of achieved energy savings, SEDA has developed special methodologies. They are facilitated for quick calculations and usually don't cover all of the variables and give fewer savings than actual.

6.7 Best practice examples

There were three official EU financial mechanisms that were based on energy audits:

- BG16RFOP002-3.001 – Energy efficiency in small and medium enterprises completed in 2018,
- BG16RFOP002-6.002 - Recovery SMEs by improving energy efficiency - completed in 2022
- SME Finance Facility Energy Efficiency (SMEFF-EE).

6.8 Summary

The energy audits (they are called official "Energy efficiency survey" in Bulgaria) in enterprises became mandatory in 2005 and are applied for large companies, industrial systems whose annual energy consumption is over 3000 MWh and external lighting systems, located in villages with a population of over 20,000 inhabitants.

Bulgarian legislation has adopted all related European energy efficiency directives and tries to reach its goals. The national Energy Efficiency Act and the ministerial decisions cover all aspects which deal with energy audits in companies. However, it does not include SMEs.

6.8.1 Strengths

The followings aspects can be listed as strengths:

- There is sufficient number of energy auditors,
- Qualification of energy auditors is generally high
- Well defined methodology
- Registry of energy auditors, energy audits
- Current energy crisis mobilized many companies to implement energy efficiency measures for their companies
- Defined quality control procedures

6.8.2 Weaknesses

The energy audits represent only a small part of the existing enterprises in Bulgaria since they are mandatory only to large companies and the biggest consumers of energy.

The energy audit procedure does not take into account non-energy benefits except CO_2 emissions.

The proposed measures are not mandatory to implement.

The quality checks are not thorough. The quality of the information received from the companies is insufficient and unreliable. The problems include: lack of available and inaccurate data from the companies, ignorance of the legal requirements, lack of specific energy goals in the companies, lack of trained energy managers.

7 Poland

7.1 Legislative requirements for enterprise energy audits

Main acts on energy audits are Law of May 20, 2016 on energy efficiency[56] (Journal of Laws of 2021, item 2166) and Law of April 20, 2021 on amending the Law on Energy Efficiency and certain other laws, which implements a provision of the Directive of the European Parliament and of the Council (EU) 2018/2002 of December 11, 2018 on energy efficiency.

Main article in the act is Article 36 on the obligation to conduct energy audit of enterprise and auditing entities.

An entrepreneur within the meaning of the Law of March 6, 2018. - Entrepreneur Law (Journal of Laws of 2021, item 162), with the exception of a micro, small or medium entrepreneur within the meaning of this Law, shall conduct an energy audit of the enterprise every 4 years or have it conducted.

There are not obliged to audit large companies if energy audit of the enterprise has been conducted as part of below systems:

- an energy management system as defined in the Polish Standard for energy management systems, requirements and recommendations for use, or
- the environmental management system referred to in Article 2 point 13 of Regulation (EC) No. 1221/2009 of the European Parliament and of the Council of November 25, 2009 on the voluntary participation of organizations in a Community eco-management and audit scheme (EMAS).

7.2 Standards, norms applied in the energy auditing practice

National legislation indicating how to perform an audit:

- Energy Law Act of April 10, 1997[57], as amended
- Construction Law of July 7, 1994[58], as amended
- Regulation of the Minister of Infrastructure dated April 12, 2002 on the technical conditions to be met by buildings and their location, as amended

[56] Ustawa z dnia 20 maja 2016 r. o efektywności energetycznej (sejm.gov.pl)
[57] Ustawa z dnia 10 kwietnia 1997 r. - Prawo energetyczne. (sejm.gov.pl)
[58] Ustawa z dnia 7 lipca 1994 r. - Prawo budowlane. (sejm.gov.pl)

- Ordinance of the Minister of Energy of October 5, 2017 on the detailed scope and manner of preparing an energy efficiency audit and methods for calculating energy savings
- Standard PN-EN 16247-1 Energy audits (4 parts: general requirements, Buildings, Processes, Transport)
- PN-EN ISO 50001 Energy management systems - Requirements and recommendations for use
- Reference document on best available techniques for energy efficiency, February 2009
- Act of August 29, 2014 on energy performance of buildings
- Ordinance of the Minister of Infrastructure and Development of February 17, 2015 on models of protocols of inspection of heating system or air conditioning system
- Decree of the Minister of Infrastructure and Development of February 17, 2015 on the manner of making and the detailed scope of verification of energy performance certificates and protocols of inspection of the heating system or air conditioning system.

The law does not specify detailed criteria on the basis of which an energy audit of an enterprise should be carried out, so it leaves it up to entrepreneurs, who have flexibility in choosing how to conduct an energy audit.

Audits are performed in accordance with the following standards: PN-EN 16247, ISO 50001, as well as the balance method and building energy performance certificates.

7.3 Auditing system and process

7.3.1 Executive bodies and their roles

The Energy Regulatory Office (ERO)[59] is responsible for verifying the obligation to perform an energy audit. The utility notifies the ERO that the obligation has been fulfilled. The ERO imposes a possible penalty for failure to perform the audit. There is no register of licensed auditors. Quality control is not conducted.

7.3.2 Auditors' network

An energy audit of an enterprise should be conducted by an entity independent of the audited enterprise, with knowledge and professional experience in conducting this type of audit. Hence, in the event that the audit is carried out by internal

[59] Energy Regulatory Office (ure.gov.pl)

experts of the enterprise, they must not be directly involved in the activity being audited. There is no register of licensed auditors.

Usually energy audits are developed by energy companies or auditing companies in general, which employ, for example, engineers (M.Sc.) and experts (of particular fields), or energy audits are performed directly by independent experts.

The law does not impose requirements on the experience of companies performing the audit, but in larger proceedings to perform an energy audit of an enterprise, it is determined by the client, for example, by requiring historically several studies in a particular industry.

The enterprise is obliged to keep, for inspection purposes, data related to the company's energy audit, for a period of 5 years. The enterprise is required to notify the President of the Energy Regulatory Office (ERO) of the energy audit conducted, within 30 days of its completion. The enterprise is required to attach the information on the possible energy savings resulting from the conducted energy audit.

There is no public database for the large enterprises and no database for the SMEs (audit is not obligatory for SMEs). ERO submits information on audits performed at large enterprises to the Ministry of Climate and Environment

7.3.3 Compliance and control, sanctions

The ERO imposes a possible penalty for failure to perform the audit. Quality control is not conducted.

The requirements are actually implemented, the Law provides for verification of the implementation of the Audit and the possibility of imposing a penalty of 5% of revenue - this is a large enough financial ailment that consciously no one evades the obligation, and unconscious non-implementation of the obligation is extremely rare as well. Rather, there are no barriers to fulfilling the obligation under Article 36 of the Law.

7.4 Audit content

7.4.1 Content

Sources responsible for at least 90% of the company's energy consumption should be reviewed in detail.

The required input data are: technical inventory of building facilities, equipment, and energy and performance monitoring data. Auditors conduct surveys and interviews during the audit.

7.4.2 Non-energy benefits

Non-energy benefits are not presented in the energy audit.

The audit should be based, if possible, on a life-cycle cost analysis of the building or group of buildings and industrial installations, rather than on a payback period, so as to take into account energy savings over the long term, residual values of long-term investments, and discount rates.

There is no obligation to provide information on CO_2 reductions as a result of retrofits, but some auditing companies provide such results.

7.4.3 Quality and presentation

The results of the energy audit are presented to the enterprise in the form of an audit report.

The main purpose of the energy audit is to find opportunities to improve energy efficiency. Usually at the beginning of the audit, these projects are listed in a table with information on energy savings (although this is not a legal requirement). Once the audit is completed, the entrepreneur notifies the ERO.

In accordance with Article 38 of the Law The entrepreneur referred to in Article 36 shall notify the President of the ERO of the conducted energy audit of the enterprise within 30 days from the date of its conduct, but no later than December 31 of the year in which the entrepreneur is required to conduct an energy audit of the enterprise. The notification shall be accompanied by information on the possible energy savings resulting from the conducted energy audit of the enterprise.

Model table of the notice:

No.	Name of venture	Average annual final energy savings (toe)*	Period of obtaining savings

*1 toe = 11,630 MWh

*1 toe = 41,868 GJ

7.5 Audit market

Companies most often choose energy auditors based on the criterion of price, followed by experience, reputation of the contractor (previous services performed).

The cost of an audit is usually between a thousand and a hundred thousand euros - the cost and time depends on the size of the enterprise, the complexity of the process, the scope beyond the minimum specified in the Law, the number of site visits, the type and number of measurements carried out, how energy is managed, and much more. There is no verification of quality, and the main criterion for selecting an auditor is price, only later opinion.

Typical measurements performed during the audit are, at the basic scope, thermovision and building inventory. The scopes most often extended are compressed air, boiler efficiency measurements.

Energy efficiency measures suggested in energy audits are any that are diagnosed at the audit stage. Typically, these include lighting and compressor modernization, use of heat recovery, thermomodernization, heat source modernization, economizer, CHP, free cooling, use of heat pumps and PV.

The decision-making process for implementing recommended measures is usually based on a simple economic evaluation of SPBT<2-4 years. Other important aspects relevant to companies in adopting energy efficiency measures in Poland are legal and social environment, CSR, consumer pressure, pressure from capital groups, and increase in fuel and energy prices, energy security.

Over 3500 large companies were audited so far. SMEs are not obliged to perform an audit so there is no data on the number of audits performed.

An entrepreneur with the exception of a micro, small or medium entrepreneur within the meaning of this Law, shall conduct an energy audit of the enterprise every 4 years or have it conducted.

Implementation of the recommended measures is not mandatory. The entrepreneur performs his own elaborate analysis of the proposals contained in the energy audit. There is no obligation to implement a specific percentage of the recommended measures.

More interest in retrofitting measures can be observed due to rising energy costs.

7.6 Calculation methodologies, tools, templates

There are no formal templates or tools for energy audits. Rather, calculation tools other than dedicated solutions in spreadsheets are used. In terms of the building, computer programs like "OZC auditor" etc. are used. In the field of PV, energy

yield simulators are used. Auditors conduct surveys and interviews during the audit.

7.7 Summary

7.7.1 Strengths

Due to the fact that the profession of corporate energy auditor is not regulated by law, this is advantageous from the point of view of companies because there is more competition and thus a greater variety of prices. If a company does not care about the quality of the audit, it chooses the cheapest offer, which is usually offered by small auditing firms. Large audit firms usually cannot 'afford' to do low-quality studies.

Both the advantage and disadvantage is that there is no specific audit template outlined by law - the advantage is that each company is slightly different and it is not possible to obtain the same amount of information for each company (example - one company has every production line metered, while another only has the buildings as a whole metered).

The strength of the AEP is the external view of the energy efficiency issues of the enterprise, which is particularly important for smaller enterprises (those that do not have people directly responsible for energy efficiency).

7.7.2 Weaknesses

The quality of the audits varies greatly, as some companies just choose the offer taking into account only the price criterion. Non-energy benefits are not at the top of the list, however, they are sometimes taken into account in the LCC economic analysis for individual projects.

8 Greece

8.1 Legislative requirements for enterprise energy audits

In Greece Law 4342/2015[60] incorporates the Energy Efficiency Directive 2012/27/EU, in the national legislation (Nov. 2015) and covers all aspects regarding energy audits in big enterprises. It is accompanied by the Ministerial Decision 175275/22.05.2018 (ΦΕΚ Β' 1927/30.05.2018)[61] which deals with the qualification and certification systems Energy Auditors, the registry of the Energy Auditors, and the Energy Audits content. Finally, ministerial Decision ΥΠΕΝ/Δ ΕΠΕΑ/49646/560/31.06.2019 (ΥΠΕΝ/Δ ΕΠΕΑ/49646/ 560/31.06.2019 (ΦΕΚ Β' 2429/20.06.2019)[62]) sets the requirements to modify an energy audit report, the person and procedure to carry out such an amendment and the documents needed.

Energy audits are mandatory for Compelled Enterprises:

- With 250 employees or more, and/or
- With less than 250 employees but their annual turnover exceeds EUR 50 million, and their annual balance sheet total exceeds EUR 43 million.

The energy audit has to be carried out every 4 years (starting from 2018).

The audit needs to cover at least 90% of the total energy consumption of the company on national territory.

Energy audits of buildings are not covered in this legislation.

8.2 Standards, norms applied in the energy auditing practice

The standards EN ISO 50001, ISO 50002, together with the European standards EN 16247 parts 1 to 5, are used for energy audits. Buildings are taken into account

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[60] https://www.buildingcert.gr/files/FEK_143A_2015.pdf

[61] http://www.et.gr/idocs-nph/search/pdfViewerForm.html?args=5C7QrtC22wG3UHk-ZeQumndtvSoClrL8V8YeS8scMDD3U4LPcASlceJInJ48_97uHrMts-zFzeyCiBSQOpYnTy36MacmUFCx2ppFvBej56Mmc8Qdb8ZfRJqZnsIAdk8Lv_e6czmhEembNmZCMxLMtabxAKJhB7rbhsMOmL4A9pCyq71jBwbDktgRA_A4t04i

[62] http://www.et.gr/idocs-nph/search/pdfViewerForm.html?args=5C7QrtC22wFqnM3eAbJzrXdtvSoClrL8FjnGp5F0IbNp6k5uE6xNduJInJ48_97uHrMts-zFzeyCiBSQOpYnTy36MacmUFCx2ppFvBej56Mmc8Qdb8ZfRJqZnsIAdk8Lv_e6czmhEembNmZCMxLMtaSneHLMaU59rzfhH1lHYkMwJbILTFwxQp5pzQeuYcE8

for their energy consumption while the procedure to calculate the energy efficiency according to the EPBD procedure (EPC calculations) is not mandatory to follow.

8.3 Auditing system and process

8.3.1 Executive bodies and their roles

The responsible body for energy audits is the Hellenic Energy Inspectorate (Southern and Northern) Departments of the Ministry of Environment and Energy - General Secretariat of Energy & Mineral raw materials. SEPDEM is the coordinator organisation of the Greek energy auditing system implementation and management. The body is responsible for

- the development and registration of the auditting network,
- supervision of the auditting network,
- quality control (compliance and control) of the energy audits,
- fines and administrative sanctions.

8.3.2 Auditors' network

An engineering degree is required to become an energy auditor. Energy auditors are independent experts or companies that employ at least one licensed expert.

Energy auditors are divided in three categories:

a) Class A: qualified engineers from the acquisition of their diploma and the graduates technical education engineers one (1) year after the acquisition of their degree, as well as the energy inspectors, who carry out category A energy audits.

b) Class B: Class A energy auditors are included after two (2) years provided they have proven conducted at least five (5) Class A energy audits, as well as the engineers who have professional experience in related energy fields works, as it will be defined by its Decision Minister of Environment and Energy of the paragraph 1 of article 17, who carry out energy audits category A and B controls.

c) Class C: energy inspectors class B with degrees in mechanical, electrical and chemical engineering, after two (2) years and as long as they have proven to have carried out at least five (5) Class B energy audits.

There are 3 categories of energy checks

Category A': residential buildings, office buildings up to two thousand square meters (2,000 m^2), shops up to two thousand square meters (2,000 m^2) and professional workshops with installed motive power not exceeding twenty-two kilowatts (22 kW) or thermal power not exceeding fifty kilowatts (50 kW).

Category B΄: office buildings over 2,000 m^2, commercial buildings over 2,000 m^2), other buildings housing tertiary sector uses (such as school buildings, hotels, hospitals, etc.) and industrial and craft facilities with a total installed capacity not exceeding 1,000 kW.

Category C΄: industrial and craft installations with a total installed power of more than one thousand kilowatts (1,000 kW).

There is no specific cost or fees to become an energy auditor.

All energy audits must be submitted in the online platform regulated by the Hellenic Energy Inspectorate Departments (https://buildingcert.gr/audits/).

There are 1423 energy audit assessors and 18 companies registered in the official energy auditors' registry (December 2022 data).

8.3.3 Reporting, audit database

The Energy Audits must be submitted in the Authority's online platform to be used by the Authority for statistics and quality checks. The Energy Audit reports must be stored by the energy auditor or the company and should be available in case of a quality inspection together with all data gathered for the specific case. The database is not public, but limited access to the data is available on request.

8.3.4 Compliance and control, sanctions

To ensure and control the quality of energy audits, the correctness of those issued of energy audit results reports, responsible are the Energy Inspection Departments of the Northern and Southern Greek Inspection Bodies of the Special Secretariat of the Body of Inspectors and Auditors of the Ministry of Environment and Energy, according to paragraph 15 of article 10 of Law 4342/2015. A 5% of the total energy audits is checked on a year basis.

If the energy auditors

a) list inaccurate energy or other data on the energy audit reports,

b) submit inaccurate data and supporting documents,

c) they violate the duty of secrecy and confidentiality, in terms of the use of the data and information they collect during the execution of their work,

d) carry out the activity of the energy auditor contrary to the provisions herein,

e) improperly fulfil their scientific and professional duties and contractual obligations,

f) they face legal or other obstacles or are incompatible,

they are faced with sanctions. These can be

1. fine from 500 to 10,000 euros or
2. exclusion of the energy auditor from conducting energy audits for a period of 1 to 3 years or
3. definitive exclusion of the energy auditor from carrying out energy audits.

Regarding the companies that do not comply with the relevant obligation a fine is issued from 5,000 to 100,000 euros.

8.4 Audit content

8.4.1 Content

The general contents of an energy audit should consist of

- Information regarding the Energy Audit team
- Details about the company
- Summary
- General data (of buildings and/or processes) & equipment related to Energy audit
- Energy Use (Balance – Apportionment) – Identification of most important uses or equipment in terms of energy consumption & any sample field measurements carried out
- Interpretation of overall energy performance and monitoring of indicators
- Life Cycle Cost Analysis – Energy Efficiency measures
- Appendices
    - Energy Baseline Calculations
    - Individual Equipment Energy Performance Report & Any Field Sample Measurements Conducted

More specifically, the energy audit report must include

    - The name and registry number of the energy auditor,
    - The code number of the energy audit,
    - The tax identification number of the audited company,
    - The date of the energy audit,
    - Description of the limits of the audit (information regarding the use and number of buildings/facilities/vehicle fleet included in the energy audit),
    - The total area and volume of the facilities/buildings checked,
- The main indicators in terms of production/activity and the size of the controlled company (production tons, number of employees, etc.),
    - The total number and characteristics of the vehicle fleet,
    - The total installed capacity (electrical, thermal),

- Consumption per use (heating, cooling, lighting, etc.),
    - Consumption by type of energy product (electricity-kWh, heating oil-tn, diesel-tn, natural gas-Nm^3),
    - The power and characteristics of Renewable Energy Sources and/or CHP,
    - Total CO_2 emissions,
    - The existence of an Energy or Environmental Management System that includes energy audits,
    - The proposed energy saving interventions,
- Information about the estimated energy savings and the payback period of the proposed interventions,
- The statement of the Energy Auditor that the audit meets the minimum requirements set by Law 4342/2015.

There is a proposed template for documentation at the ministry site, together with a spreadsheet for the energy calculations[63].

8.4.2 Non-energy benefits

The only mandatory non-energy benefit indicator is CO_2 emissions. Other non-energy benefits are not mandatory on energy audits, and the energy auditor may decide to explain and include NEBs in his report.

8.4.3 Quality and presentation

There are no available official quality restrictions.

The energy savings change significantly depending on the company, the sector, and the proposed measures.

8.5 Audit market

There are approx. 1200 large companies in Greece. The first energy audits were submitted in December 2018, and quality checks started early 2020.

Audits are mandatory for large companies only. SMEs are not subject to mandatory energy audits.

[63] https://ypen.gov.gr/energeia/energeiaki-exoikonomisi/energeiakoi-elegchoi/

The cost for an energy audit depends on the size of the company, its sites, and the complexity of its processes. It normally ranges between 4000 and 6000 euros, but it can vary in a wide range.

Companies select the energy auditors from the official registry of auditors published on the website of the Authority[64].

The implementation of the proposed energy saving measures in the audits is not mandatory. Up to now, no market research on the level of implementation of the recommended energy audit measures has been carried out.

In case a company implements an energy management system that complies with EN ISO 50001, it does not need to carry out an energy audit. The cost of an EN ISO 50001 energy report is about one third of the cost of an energy audit, but it has to be carried out annually instead of every four years. In Greece, many companies have decided to apply an energy management system.

8.6 Calculation methodologies, tools, templates

There are no mandatory templates or tools for energy audits. However, the Ministry has prepared a detailed guide for energy audits covering all possible market sectors[65]

A questionnaire has also been prepared which covers all possible sources of energy intervention, and can be used by the energy auditor and the audited company[66]

However, the energy auditor is free to use any tool to access the current energy performance of the company. Usually, energy auditors visit the industry and collect energy consumption data, general data of the processes, production data, bills, building and equipment data, etc.

8.7 Best practice examples

CRES has been involved in European project SteamUp (https://steam-up.eu/en) in which the energy efficiency in Steam industries was the ultimate task. During the course of the project, 75 detailed audits in industries were carried out and apart for the possible energy savings from the proposed measures, a long list of

[64] https://www.buildingcert.gr/enaudits/faces/public/List.xhtml
[65] https://ypen.gov.gr/wp-content/uploads/2020/11/Odhgos_energeiakwn_elegxwn_Part1.pdf, and https://ypen.gov.gr/wp-content/uploads/2020/11/Odhgos_energeiakwn_elegxwn_Part2.pdf
[66] https://ypen.gov.gr/wp-content/uploads/2020/11/Odigos_energeiakwn_elegxwn_Prosthiki3.xlsx

NEBs was prepared. However, these benefits were mainly qualitative and not quantitative.

8.8 Summary

The energy audits (they are called "energy checks" in Greece) in enterprises became mandatory in 2018 and apply in large companies only. Greek legislation has adopted all related European energy efficiency directives and tries to reach its goals. The national Law (4342/2015) and the ministerial decisions cover all aspects which deal with energy audits in companies. However, it does not include SMEs.

8.8.1 Strengths

The following positive aspects can be listed:

- There are enough energy auditors,
- The qualifications of energy auditors is high,
- The methodology is well defined,
- Registry of energy auditors, energy audits works well,
- Current energy crisis mobilized many companies to implement energy efficiency measures for their companies,
- The quality control procedures are well defined.

8.8.2 Weaknesses

The following weaknesses can be identified:

- The energy audits represent only a small part of the existing enterprises in Greece since they are mandatory only to large companies.
- Low motivation from the companies because they usually think is just another "typical" obligation.
- The energy audits procedure does not take into account non-energy benefits except CO_2 emissions.
- The proposed measures are not mandatory to implement.
- The quality checks are not thorough. The quality is moderate and not reliable enough.
- The problems include: not available and accurate data from the companies, generic requirements for the energy audits by the laws, decisions, etc., absence of specific energy goals from the law, absence of energy auditors training.

9 Italy

9.1 Legislative requirements for enterprise energy audits

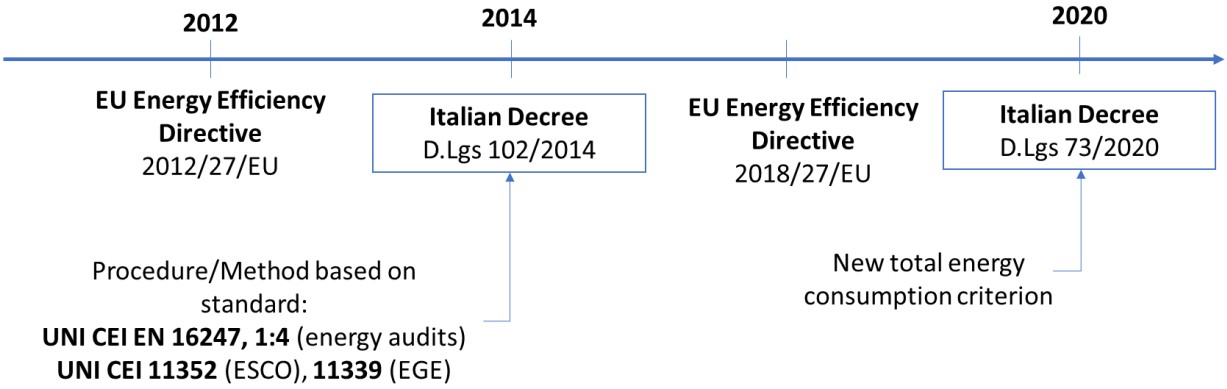
In Italy, there are legislative requirements for enterprise energy audits that are designed to promote energy efficiency and reduce carbon emissions. The main legislation governing energy audits in Italy is the **Legislative Decree 102/2014**[67], which transposes the European Union's Energy Efficiency Directive (2012/27/EU) into Italian law. Under this law, large enterprises in Italy are required to conduct energy audits at least once every four years. Large enterprises are defined as those that meet at least one of the following criteria:

1. A number of employees ≥ 250 and an annual turnover > € 50 million and an annual budget > € 43 million
   or
2. A number of employees ≥ 250 and an annual turnover > € 50 million
   or
3. A number of employees ≥ 250 and an annual budget > € 43 million

With **D.Lgs 73/2020** a new criterion based on total energy consumption was introduced. Large companies with total consumption of less than **50** toe are exempted from the mandatory energy audit.

Small and medium-sized enterprises (SMEs) are exempt from the mandatory energy audits, but they may still choose to conduct energy audits voluntarily in order to improve their energy efficiency.

The energy audits must be conducted by qualified professionals who are registered by the Italian Ministry of Economic Development (MISE). The audits must include a comprehensive analysis of the enterprise's energy consumption and identify opportunities for energy efficiency improvements. The results of the audit must be reported to the Ministry of Economic Development.



[67] https://www.gazzettaufficiale.it/eli/id/2014/07/18/14G00113/sg

9.2 Standards, norms applied in the energy auditing practice

In Italy, energy auditing practices are guided by a set of standards, norms and guidelines that aim to ensure consistency and quality in the audit process. These standards and norms are established by various organizations, including the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA), the Italian Ministry of Economic Development (MISE), and the Italian Association of Energy Auditors (AIGE).

Here are some of the standards and norms applied in the energy auditing practice In Italy:

1. **Guideline 102/2014**–- This guideline was developed by ENEA and provides guidelines for conducting energy audits in companies, including the scope of the audit, data collection, analysis, and reporting.
2. **UNI EN 16247-1:4:2012**–- This European standard sets out the general requirements for energy audits, including the methodology and process for conducting audits, and the scope and content of the audit report.
3. **Legislative Decree 102/2014**–- As mentioned earlier, this legislation transposes the European Unio''s Energy Efficiency Directive into Italian law, and sets out the requirements for energy audits in large enterprises.
4. **AIGE Technical Guidelines**–- The Italian Association of Energy Auditors (AIGE) provides technical guidelines for energy auditors, including best practices for energy audits and recommendations for energy efficiency measures.

These standards, norms, and guidelines provide a basis for energy auditors to conduct comprehensive and effective energy audits and ensure that the results of the audits are reliable and consistent.

9.3 Auditing system and process

9.3.1 Executive bodies and their roles

The executive bodies involved in the enterprise energy audit process include:

- **Ministry of Economic Development** (**MISE**): MISE is responsible for promoting energy efficiency and renewable energy sources in Italy. It establishes the regulations and guidelines for enterprise energy audits and monitors their implementation.
- **Regional Governments**: Regional governments are responsible for implementing energy policies at the regional level. They coordinate and supervise the activities of the local authorities in their respective regions, including enterprise energy audits.
- **Local Authorities**: Local authorities are responsible for promoting energy efficiency and renewable energy sources within their territories. They are required to encourage and support enterprises to carry out energy audits.
- **Accreditation Bodies**: Accreditation bodies are responsible for certifying energy auditors and ensuring that they meet the required standards. They also provide training and support to energy auditors.
- **Energy Auditors** (**EGE**) Energy auditors are professionals who carry out energy audits. They are responsible for identifying energy-saving opportunities and recommending energy efficiency measures for enterprises.
- **Energy Service Companies** (**ESCOs**): ESCOs are private companies that provide energy efficiency services, including enterprise energy audits. They are responsible for conducting energy audits for enterprises and implementing energy efficiency measures.

In addition to the executive bodies mentioned previously, the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (**ENEA**) also plays a role in the enterprise energy audit process in Italy. ENEA is a public research institution that works to promote sustainable development and energy efficiency in Italy. Its specific roles related to enterprise energy audits include:

- Providing technical support and advice to enterprises and energy auditors: ENEA provides technical assistance and support to enterprises and energy auditors in carrying out energy audits. This includes providing guidelines and tools for energy auditors to use during the audit process.
- Monitoring and assessing the results of enterprise energy audits: ENEA is responsible for monitoring and assessing the results of enterprise energy audits. It evaluates the energy efficiency measures recommended by energy auditors and ensures that they comply with national regulations and standards.

- Promoting energy efficiency and sustainable development: ENEA promotes energy efficiency and sustainable development by disseminating information on best practices and technologies for energy efficiency in the enterprise sector. It also works to raise awareness among enterprises and the general public about the benefits of energy efficiency.

ENEA plays a key role in promoting energy efficiency and sustainable development in Italy, including through its support for enterprise energy audits. Its activities complement the roles of other executive bodies involved in the enterprise energy audit process.

9.3.2 Auditors' network

According to Legislative Decree 102/2014, energy audits in Italy can be carried out by qualified energy auditors (EGE) or by energy performance companies (ESCO). Specifically, the energy audit must be carried out by professionals who:

1. Possess a degree in engineering, architecture, physics, or chemistry, or have a diploma from a technical institute in one of these subjects, or have equivalent qualifications recognized by the Italian state.
2. Have completed a course of study in energy management, energy efficiency, or renewable energy, and have obtained a certificate of competence recognized by the Italian state.
3. Have at least two years of professional experience in the field of energy efficiency or renewable energy.
4. Are registered in a special register of energy auditors established by the Ministry of Economic Development (MISE).

It is worth noting that ENEA provides training and certification courses for energy auditors in Italy. Energy audits carried out by non-qualified professionals are not recognized as valid under the legislation.

The cost to become a qualified energy auditor in Italy can vary depending on the training program or certification course that the individual chooses to follow. The cost of these programs can range from a few hundred euros for basic training courses to several thousand euros for more advanced programs. In addition to the cost of the training or certification program, individuals will also need to pay an annual fee to maintain the certification.

According to a database published by ACCREDIA, 3100 energy auditor certificates have been issued and almost 350 ESCOs have been certificated.

9.3.3 Reporting, audit database

With collected data from energy audits, ENEA delivers regularly benchmarking reports for specific productive sectors (e.g. glass or cement industry) with the definition of energy indicators. These are helpful for the companies:

1. to figure out the gap in terms of efficiency from the most energy efficient companies,
2. to identify the "best available techniques" (BAT) for a specific field.

In terms of storing audit reports, ENEA and MISE request that companies or energy auditors submit electronic copies of the audit reports for review and approval. The reports are typically stored on secure servers or databases, which are accessible only to authorized personnel.

9.3.4 Compliance and control, sanctions

In Italy, compliance and control of enterprise energy audits are primarily the responsibility of the MISE. The MISE has the power to carry out inspections of energy audits and to verify compliance with the requirements set out in Legislative Decree 102/2014. If a company fails to carry out an energy audit in compliance with the legislation or fails to submit the required documentation to the MISE, they may be subject to sanctions. The sanctions for non-compliance can include fines ranging from €2,000 to €40,000, depending on the severity of the violation:

- 4,000€ - 40,000€ in case the enterprise has not submitted to ENEA the energy audit results;
- 2,000€ to 20,000€ if the energy audits has not been accomplished as prescribed by D.Lgs 102/2014 Art 8 (EN16247, etc.).

In addition, companies that fail to comply with the energy efficiency requirements set out in the legislation may also be subject to other sanctions. These sanctions may include the revocation of incentives or tax credits, or the prohibition on participating in public tenders for a certain period of time.

ENEA supports technically MISE for verifying and checking the compliance of energy audits carried out in accordance with the D.lgs. 102/2014. ENEA checks at least 3% of the total presented energy audits. In addition, ENEA controls 100% of the total presented energy audits in case these are developed by an internal auditor. ENEA has established a system for checking energy audits to ensure that they meet the necessary standards and requirements. The system involves several steps, including:

1. Quality control of the energy audit report: ENEA reviews the energy audit report to ensure that it meets the requirements of the 102/2014 guideline, including the presentation of data, calculation methodologies, and recommendations for energy-saving measures.
2. Verification of data: ENEA verifies the accuracy of the data collected during the audit, including energy consumption data, and may request additional data or measurements if necessary. ENEA can perform an on-site visit if it deems appropriate.
3. Technical verification: ENEA verifies the technical feasibility and potential energy savings of the recommended energy-saving measures.

4. Verification of compliance: ENEA verifies compliance with legal requirements, such as the requirement to use qualified energy auditors and to follow the standardized methodology set out in the 102/2014 guideline.
5. Issuance of the energy audit certificate: Once the energy audit has been verified, ENEA issues a certificate of compliance to the company or organization that commissioned the audit. The certificate is valid for four years and must be renewed after this period.

9.4 Audit content

9.4.1 Content

An energy audit report shall incorporate at least the following contents:

1. **Details of the expert carrying out the energy audit**: this section should be filled with detailed data on the energy audit expert, specifying if he/she is an internal or external qualified professional and his/her professional qualification. Within the Italian transposition of article 8 are entitled to carry out an energy audit only: Energy Management Experts according to the National standard UNI CEI 11339; Energy Service Companies according to the National standard UNI CEI 11352; Energy auditors.
2. **Obligated party details**: general data useful to identify the obligated enterprise, such as number of employees, sector, NACE code, turnover and balance sheet. Where applicable, details shall be provided on the full or partial ownership of other companies' shares; where applicable details shall be provided on the parent companies and third parties owning shares in the enterprise itself.
3. Reference period of the energy auditing process.
4. **Units of measure and reference values**, including correction and normalization parameters whenever adopted (such external temperature or Heating Day Degrees).
5. **Data collection procedure**: a list of the type of measurements (spot or continuous, direct or indirect) shall be provided. For the enterprises falling into the first obligation period, it has not been considered compulsory to have been implemented a dedicated measurement system, while a utility meter has been considered enough for the purposes of article 8 implementation. For solid or liquid fuels the purchasing invoices have been considered satisfying. It is also required to provide detailed information on the employed meters, including the typology, the accuracy and the calibration procedure. For the new energy audit session (2019) it will be necessary to implement a more detailed energy management measurement procedure.
6. **Products**: it is requested a detailed description and identification of delivered products, including semi-finished ones. For each product shall be provided at least the annual quantity with the associated unit of measure.

7. **Raw materials**: a list of type and quantities of the materials employed in the process.
8. **Production process**: description of the production process, flowchart including all the energy vectors and all the process phases.
9. **KPIs**: for the process under consideration a set of reference KPIs shall be listed in detail. KPIs can be found in technical literature, international and national standards. If any information about KPIs is not available, any assumption shall be explained in detail. Anyway, at least general KPI shall be listed based on the total output and total consumption for each energy vector on a three years base.
10. **Energy consumption**: the consumption of the below listed energy vectors shall be listed, taking in account that total consumption shall include also the amount of energy self-produced and used in the plant:
11. **Energy models:** development of models for energy vector entering the plant.
12. Determination of actual KPIs and comparison with reference KPIs.
13. **Energy Measures** implemented in the past
14. **List of Energy Measures** for each energy measures the following information shall be reported:
    - detailed technical description, as far as possible and where applicable, including documentation relating to the component, system, process interested by the measure itself;
    - cost benefit analysis based on NPV/I;
    - planning of measures and assessments to verify the energy savings obtained by the implanted measures; for each measure the relevant instrumentation shall be listed;
    - opportunity to obtain local and state incentives.

Energy auditors typically do not make surveys (questionnaires), however, in the inspection phase, they conduct interviews. The purpose of these interviews is to gather information about the energy use and performance of the facility, as well as to identify opportunities for energy efficiency improvements. During the inspection phase of the audit, the auditor will physically inspect the building or facility and collect data on the plant envelope, lighting, heating, ventilation, air conditioning, and other energy-consuming systems. In addition, the auditor may also conduct interviews with facilities occupants, maintenance personnel, and other relevant stakeholders to gather information on energy use patterns, operational practices, and potential barriers to energy efficiency improvements. All of the data collected during the inspection and interview process is used to fill the energy audit report.

9.4.2 Non-energy benefits

Non energy benefit analysis is not required for the Italian energy audit in enterprises. However, the current economic/political situation has increased companies' interest in energy management. In particular, companies are learning

that it is possible to profit from the multiple benefits of energy efficiency investments (e.g. DEESME Project).

9.4.3 Quality and presentation

As discussed in Paragraph 9.3.4, ENEA has established a system for checking the quality of energy audits conducted under the Italian Legislative Decree 102/2014. This system is designed to ensure that energy audits are conducted in compliance with the requirements of the Legislative Decree 102/2014, and that the results of the audits are accurate and reliable. The system involves a process of independent verification, in which a sample of energy audits is randomly selected and audited by ENEA to ensure that they meet the required standards. This system is intended to provide assurance to businesses and other organizations that the energy audits they commission meet the necessary standards of quality and accuracy.

The results of an energy audit are typically presented to enterprises in the form of an energy audit report, which includes a comprehensive analysis of the energy use and performance of the plant, as well as recommendations for energy efficiency improvements. In addition to the audit report, the energy auditor may also provide a presentation to the enterprise to discuss the audit findings and recommendations in more detail. This may include a question and answer session to address any concerns or questions the enterprise may have.

The average potential savings obtainable by a company thanks to energy efficiency investments or interventions is around 19% - 30%, with peaks reaching 40% where interventions are made on plants that have never implemented an integrated energy requalification approach.

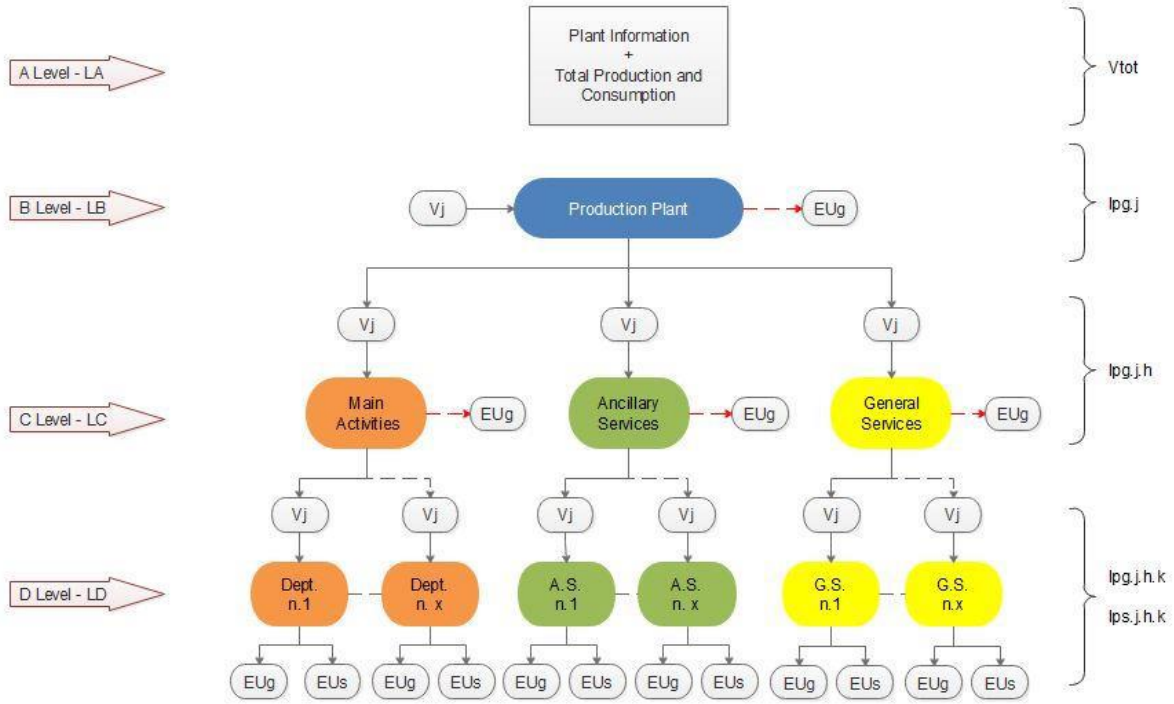
According to co 3, Art.8, DLgs 102/14 energy intensive companies re obliged to implement the measures suggested in the energy audit or to certify ISO 50001.

9.5 Audit market

The cost and time required for an energy audit can vary depending on a number of factors, including the size and complexity of the facility being audited, the scope of the audit, and the qualifications and experience of the energy auditor. In general, the cost of an energy audit will depend on the level of detail required, with more comprehensive audits typically costing more than basic audits. According to SOGESCA practice, the cost of an energy audit for a small or medium-sized enterprise (SME) can range from €3,000 to €10,000 or more, depending on the level of detail required and the qualifications of the auditor.

9.6 Calculation methodologies, tools, templates

The calculation methodology for energy audits in Italy is defined in the energy audit guideline 102/2014 issued by ENEA. The methodology is based on the European Union's Energy Efficiency Directive (EED), which requires member states to develop a standardized methodology for energy audits. The methodology defines a plant energy model. This model can be defined as the description of each energy vector use within the plant boundaries. The level of detail depends on the availability of direct measures and on the relevance of the area of interest. The energy model should be built considering each energy vector (electrical, thermal, steam, etc.) purchased and used on-site; its main purpose is the allocation of any specific vector among the different users. An inventory of the systems and components with their associated energy consumption will complete the scheme.



The energy model has a tree structure as shown in previous figure and should be designed for each energy vector used in the plant. Plant activities are structured according to three main categories (or "phases"): Main activities, Auxiliary services and General services. Once the consumption of each identified phase has been provided, the "Plant Energy Structure" allows to assign an energy performance index (specific consumption) to each phase performed in the company, correlating the energy consumed both with the end use (EUg) and if case with its specific use (EUs).

There are no mandatory calculation software. ENEA developed a calculation software (Tool ENEA Efficiency 1.0). This tool can be used by companies for estimating a raw energy efficiency of their processes. However, this tool is just suggested and non-energy benefits are not included.

9.7 Summary

9.7.1 Strengths

The energy audit required by the Italian Legislative Decree 102/2014 can have several strengths in relation to a company's awareness and consciousness of energy-related issues. By raising awareness, encouraging action, enhancing reputation, and promoting compliance with legal requirements, the energy audit can help companies to become more energy-conscious and environmentally responsible.

9.7.2 Weaknesses

The major weakness in the Italian audit market is the perceived lack of value from the companies. If companies do not understand the benefits of an energy audit or are not convinced of the value of the recommendations made in the audit, they may be reluctant to invest in this type of assessment.

Annex 1: Mandatory audit information in Spain

1. Consumption of final energy (kWh/yr) …….
Divided into:
– electric energy (kWh/yr),
– thermal energy (kWh/yr),
– transport (kWh/yr)

2. Estimated final energy savings (kWh/yr) ……
Divided intro:
– electric energy (kWh/yr),
– thermal energy (kWh/yr),
– transport (kWh/yr)

3. Avoided CO2 emissions estimated (tCO2 e/yr) ……...

4. Estimated investment to perform the energy saving measures (€) …….

6. Payback (yrs) ……

6. Final energy savings related to energy saving measures implemented from previous energy audits (kWh/yr): ……..
Divided for every implemented measure:
i. General information:
– Name of the measure: ……
– Description: ……..……
– Date of implementation: ……..……
ii. Economic data:
– Total investment (€) ……..
– In case of receiving public financing:
• Name of the financing programme: ….……
• Amount received (€): ……..……
iii. Energy data:
– Saved final energy (kWh/yr): ……
Divided into:
– electric energy (kWh/yr),
– thermal energy (kWh/yr),
– transport (kWh/yr)

7. Percentage of the energy consumed by the site respect to the total final energy consumed by the company on national territory [%] ……

- For the economic assessment, it is not mandatory but recommended to include the internal rate of return or net present value

Annex 2: Standardised summary report, Austria

The standardised summary report (short version) of an audit shall contain the following information:

About the company:

1. General description of the company and its activities
2. information on energy consumption for all energy sources used as well as the waste heat potentials;
3. main energy consuming factors and the main energy consumption areas;
4. relevant measures to increase energy efficiency, indicating the annual savings potential per measure in kWh, the investment costs and the annual energy cost savings in the main energy consumption areas;
5. dynamic economic efficiency calculations (alternatively static calculation, but then a justification);
6. information on the energy efficiency measures implemented in the last four years; they shall document which recommendations from a previous energy audit report have been implemented and give reasons if recommendations from a previous energy audit report have not been implemented;
7. information on the reported energy performance indicators and their development over the last four years;

Information about the auditor:

Name and qualification including re-qualifications of the auditors

If there is an energy management system

the person responsible for the management system.

the respective certificates or registration numbers and their validity.

To demonstrate that the audit is being carried out in the company.

- it shall be signed by the managing body of the obliged entity
- the managing body of the obliged entity shall submit the energy audit report to the supervisory or control body and report on the recommendations;

In addition, the following steps are to be taken within the single sector:

Buildings:

a) Ownership and use agreements to show possibilities to influence energy consumption;
b) Type of building use;
c) Identification and analysis of the current condition of the thermal building envelope

d) identification and analysis of the main energy-relevant parts of the technical equipment of buildings
e) climatic requirements inside the building; and
f) analysis of user behaviour.

Production processes:

a. energy-relevant production and equipment processes;
b. replacement, modification or upgrading of equipment;
c. company-specific measures that ensure more efficient operation, ongoing optimisation and improved maintenance.

Transport:

d. survey
    a. the classes of motor vehicles used;
    b. the total energy consumption;
    c. the energy sources used; and
    d. the mileage and main technical characteristics of each motor vehicle.
e. Examination of company-specific improvement measures in the case of
    a. route optimization or route planning;
    b. more efficient operation of motor vehicles;
    c. energy- and CO2-relevant specifications for the acquisition of motor vehicles;
    d. maintenance programs; and
    e. alternative business travel, employee mobility or customer mobility management.

Annex 3: Standardized summary report, Bulgaria

The standardized summary report (short version) of an audit in Bulgaria shall contain the following information:

About the company:

1. general description of the company and its activities
2. information on energy consumption for all energy sources used as well as the waste heat potentials;
3. main energy consuming factors and the main energy consumption areas;
4. relevant measures to increase energy efficiency, indicating the annual savings potential per measure in kWh, the investment costs and the annual energy cost savings in the main energy consumption areas;
5. dynamic economic efficiency calculations (alternatively static calculation, but then a justification);
6. information on the energy efficiency measures implemented in the last four years; they shall document which recommendations from a previous energy audit report have been implemented and give reasons if recommendations from a previous energy audit report have not been implemented;
7. information on the reported energy performance indicators and their development over the last four years;

Information about the consultant's company and auditor:
Name and qualification of the auditors

If there is an energy management system
the person responsible for the management system.
the respective certificates or registration numbers and their validity.

To demonstrate that the audit is being carried out in the company.

- it shall be signed by the managing body of the obliged entity
- the managing body of the obliged entity shall submit the energy audit report to the supervisory or control body and report on the recommendations.

In addition, the following steps are to be taken within the single sector:

Buildings:
g)ownership and use agreements to show possibilities to influence energy consumption;
h)type of building use;

i) identification and analysis of the current condition of the thermal building envelope
j) identification and analysis of the main energy-relevant parts of the technical equipment of buildings
k) climatic requirements inside the building;
l) analysis of user behavior.

Production processes:
f. Technological processes;
g. Material and energy flows;
h. Production machinery and equipment;
i. Fuel combustion and energy transformation;
j. Electricity production;
k. Electricity supply;
l. Instruments for measurement and control;
m. Heating and ventilation;
n. Compressed air system;
o. Lighting;
p. Air conditioning;
q. Water system;
r. Building envelope
s. analysis of user behavior.

An analysis of the applicability of renewable energy sources, such as recommendations for more efficient operations, is mandatory. For buildings, an asset calculation method based on building physics parameters shall be used, based on the national calculation rules (Norm RD-04-05). The proposed measured retrofit and energy savings and associated costs shall be included in the following structure:

- measures not requiring investment (simple),
- measures that can be economical without any subsidy (cost-optimal),
- measures currently only realistic with subsidies (costly)

An economic analysis is also required, but simple payback times are sufficient. Measurements are not mandatory. There is no official template for documentation, only the dataset uploaded to the official platform has a mandatory structure and content.

The Energy Audit Summary template content:

- The actual energy consumption and important conclusions
- Suggested energy saving measures (ESM)
- General description
- Expected energy savings
- Expected money savings
- Required investments
- Payback period
- CO_2 emissions savings

Annex 4: Cross country comparison

	LV	***HU***	***PT***	***SP***	***AT***	***BG***	***PL***	***GR***	***IT***
	EKO	***BME***	***ISR-UC***	***ESCAN***	***E7***	***CISB***	***KAPE***	***CRES***	***SOG***
Population	*1.9 million*	*9.7 million*	*10.3 million*	*47.4 million*	*9.0 million*	*6.9 million*	*37.8 million*	*10.6 million*	*59.1 million*
No. of large companies	*276*	*cca. 5,200*	*13,603*	*4,977 (2022)*[68]	*2,702*	*754*	*cca 3,600*	*cca. 1,200*	*cca. 3,600 (latest official statistics of 2016)*
No. of audits so far	*457 (officially registered)*	*2,722 (till end 2022)*	*551 (last three years)*	*10,600 every year*	*1,910*	*3,950*	*Not known*	*900 (till end 2022)*	*812 (till end 2021)*
No. of SMEs	*108 160*	*884 476*	*1314944*	*2,923,729 (2022)* [69]	*385.000*	*411 246*	*cca 2,2 million*	*712.060*	*Almost 3.8M*
No. of auditors	*7 accredited energy audit companies*	*Licenced persons: 170 Licenced companies: 86*	*213*	*Not known*	*614*	*Licensed persons: 924 Licensed companies for processes: 52*	*Not known*	*Licenced persons: 1423 Licenced companies: 18*	*Licenced almost 3100 Licenced companies (ESCOs): 350*

[68] Source: http://www.ipyme.org/Publicaciones/CifrasPYME-enero2022.pdf
[69] Source: http://www.ipyme.org/Publicaciones/CifrasPYME-enero2022.pdf

	LV	***HU***	***PT***	***SP***	***AT***	***BG***	***PL***	***GR***	***IT***
	EKO	***BME***	***ISR-UC***	***ESCAN***	***E7***	***CISB***	***KAPE***	***CRES***	***SOG***
						Licensed companies for buildings: 256			
Audit results availability	*No*	*Partly upon request*	*No*	*Depends on the region*	*No*	*No*	*No*	*Only upon request*	*Partly*
Mandatory tools	*No*	*No*	*No*	*No*	*No*	*No*	*No*	*No*	*No*
Mandatory questionnaires	*No*	*No*	*No*	*No*	*No*	*No*	*No*	*No*	*No*
Audit registry	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*N/A*
Proportion of checked audits	*Not known*	*7,9%*	*68%*	*Not known*	*4%*	*4%*	*No*	*5%*	*3%*
Cost of an audit (1000 euros)[70]	*2-5*	*4-6*	*5-10*	*Less than 15*	*6–8*	*6-8*	*2-3*	*3-5*	*3-10*
EPC included in an audit	*Optional (mostly not)*	*Optional (mostly)*	*Optional*	*No*	*No*	*Optional (mostly)*	*Optional (mostly not)*	*No*	*No*
EPB standards are used for building calculations	*Yes*	*Optional (mostly not)*	*Optional*	*No*	*No*	*Yes*	*Optional (mostly not)*	*No*	*No*

[70] Cost of a 5000 m^2 building with no special technology

	LV	***HU***	***PT***	***SP***	***AT***	***BG***	***PL***	***GR***	***IT***
	EKO	***BME***	***ISR-UC***	***ESCAN***	***E7***	***CISB***	***KAPE***	***CRES***	***SOG***
Dynamic simulation is used for calculations	*Optional (mostly not)*	*Optional (mostly not)*	*Under SCE, yes, for large buildings*	*Optional (mostly not)*	*Optional*	*Optional*	*Optional (mostly not)*	*Optional (mostly not)*	*No*
Questionnaires / interviews applied during audit	*Yes (no unified template available)*	*Optional (mostly not)*	*Optional*	*Optional (sometimes)*	*No*	*Yes*	*Yes*	*Optional (sometimes)*	*Optional. Interview at the beginning audit phase*
NEBs inclusion	*Only CO_2 emission*	*Only CO_2 emission*	*Only CO_2 emission*	*Only CO_2 emission*	*Only CO_2 emission*	*Only CO_2 emission*[71]	*Optional CO_2 (mostly not)*	*Only CO_2 emission*	*No*

[71] In some EU programmes: Increased productivity; Indoor climate condition; Level of energy efficiency in the building structures; Water treatment; Waste management