Comparative study on quality assurance for mandatory energy audits in Romania and Germany

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Abstract. *The commitment to an activity always requires the assurance of the quality of the result. Article 8 of the Energy Efficiency Directive 2012/27/UE of the European Parliament (EED) requires large companies in all member states to carry out an energy audit at least every four years. An energy audit follows the standard EN-16247-1, but this standard does not take into account a possible reluctance of the company carrying out the audit and thus compliance with a minimum qualitative standard. The various national implementations therefore define further rules for carrying out these audits. In Romania, Article 8 of the EED was implemented in the National Energy Efficiency Action Plan (NEEAP). The coordinating authority for the energy audits is the Autoritatea Nationala de Reglementare în domeniul Energiei (ANRE). In Germany, the Erneuerbare Energien Gesetz (EEG) was created for this purpose, with the Bundesamt für Wirtschaft und Ausfuhrkontrolle (BAFA) being responsible for coordination. This study compares the differences in the respective regulations. In a comparative review, we analyze the national rules that companies in Romania and Germany have to follow when carrying out audits. Factors such as minimum sizes, balance sheet limits, calculation of measures, qualification of the auditor and also sanctions in the event of violation of the audit obligation are compared. This is intended to enable conclusions to be drawn as to whether there are differences in the requirements and minimum quality of energy audits in different countries and what influence the mandatory audit has on companies.*

Keywords: Energy audits, audit quality, mandatory audits, voluntary audits

Introduction

Energy Efficiency Directive 2012/27/UE of the European Parliament (EED) (EuropeanParliament, 2012), Article 8, called on the European Member States to create a law obliging large companies to carry out an energy audit at least every four years. This transposition has now been carried out in all 28 Member States. In addition to the laws passed by parliament, further decisions have been published in the form of guidelines by the relevant national authority to ensure the quality of the audits to be carried out. With this comparative study, we examine both the parliamentary legislation and the extra-parliamentary regulations for the countries Romania and Germany for the implementation of the audit obligation. The examination of the extra-parliamentary documents should provide information about the minimum criteria required for audits and auditors.

For comparisons of the parliamentary laws of the Member States, there are numerous studies that document the transposition of EED of selected or all Member States. For example,

the Demand Response status report (Bertoldi, Zancanella, & Boza-Kiss, 2016) is devoted to the transposition of Article 15 in each of the Member States, while (Forster, Kaar, Rosenow, Leguijt, & Pato, 2016) compare the implementation of Article 7 in all 28 Member States. For Article 8, very detailed comparisons can be found in (Hirzel, 2016) and (Nabitz & Hirzel, 2019), which, among other things, evaluate the respective National Energy Efficiency Action Plans (NEEAP). Since the NEEAPs of the Member States appeared at about the same time as the transpositions of Article 8, the consideration of the Romanian National Energy Efficiency Action Plan 2014 - 2020 (României, 2015) and the study of the German NEEAP (BAFA, 2017) must also be included in our comparison.

The studies and sources mentioned are usually limited to parliamentary legislation. For the non-parliamentary legislation, the respective specifications of the national authorities have to be examined. In Romania there are the so-called Decisions of the Autoritatea Națională de Reglementare în domeniul Energiei (ANRE), in Germany further instruction sheets and guidelines are published by the Bundesamt für Wirtschaft und Ausfuhrkontrolle (BAFA). If one compares these documents, one can also examine the implementation of the audit obligation in terms of qualitative aspects.

This comparative study is prefaced by our hypothesis, which assumes equality of conditions, so that there is no locational disadvantage for large companies in terms of mandatory audits. The result of the study can show companies this potential locational disadvantage, but it should also help legislators to make future regulations more uniform and thus more equitable.

Methodology

First, we examine the EED for common components concerning the mandatory energy audits. These requirements are less precise and apply uniformly to all Member States. Looking for data on the total number of audits carried out, we make some assumptions and interpolate from similar studies, in particular the National Energy Efficiency Action Plans of the two countries and the national reports on the implementation of the EED. Since the national transposition of the EED can and should take into account country-specific characteristics, we also compare the most important energy-specific key indicators of Germany and Romania. In addition to the national reports on implementation, we also examine data sets from Eurostat on the most important energy policy figures of the two Member States. The next step of the literature search concerns the analysis of parliamentary laws as well as additional, non-parliamentary regulations from Romania and Germany. In this context, we specifically research minimum criteria which have an impact on the quality of the mandatory audits or which significantly influence the effort and costs of the audit.

Based on the results of this literature study we develop a catalogue of criteria to compare the qualitative aspects of energy audits. These criteria will then be compared according to the possibilities for both countries. By comparing these criteria, we can specifically identify the differences in the two countries and identify differences in the quality of energy audits. If there are significant differences in the minimum criteria or in factors that influence the cost of an audit, we must reject our hypothesis.

Requirements for audits according to EED

The origin of mandatory energy audits lies in the European Energy Efficiency Directive (EED) (European Parliament, 2012), which has now been transposed into national laws in all member

states. The entire EED pursues the goal of reducing dependence on energy imports and limited resources, among other objectives, through a Europe-wide annual energy saving of 1,5 percent for the Member States in the period 2014 to 2020. The EED is a framework of 30 articles, whereby the subject of our study focuses on Article 8 - energy audits and energy management systems - and annex VI, which describe minimum criteria for energy audits.

The obligation for energy audits is laid down in EED Article 8 (5):

“Member States shall ensure that enterprises that are not SMEs are subject to an energy audit carried out in an independent and cost-effective manner by qualified and/or accredited experts or implemented and supervised by independent authorities under national legislation by 5 December 2015 and at least every four years from the date of the previous energy audit.” (source: (EuropeanParliament, 2012))

The definitions in EED Article 2 (26) describe three criteria by which companies are defined as "not SME". The primary criterion is the number of employees (over 250), further criteria are the annual balance sheet total (over 43 M€) and the annual turnover (over 50 M€). According to Article 8 (6), large companies are also not required to comply if they have established a certified energy management system or environmental management system, for example according to ISO 50001 (Standardization, 2018) or according to the European eco management and audit scheme (EMAS). The amendment of the EED from 2018 (EuropeanParliament, 2018a) makes no changes to Article 8.

The obligation to carry out audits must also take into account the handling of multi-national and multi-site companies. There is no specific guideline or further definition for this in the EED. In the case of non-compliance with the national provisions adopted, the Member States should, according to Article 13 EED, take into account a penalty for which no specific amount is given.

Annex VI provides guidelines for energy audits, which apply both to voluntarily funded audits, audits within the framework of management systems and to the mandatory audits in accordance with Article 8. These requirements are intended to ensure a minimum quality of the audits carried out:

The audit must be comprehensive enough to provide a holistic and representative picture of the company. The audit should clearly reflect the energetic profile of the company and, depending on the type of company, focus on buildings, groups of buildings, industrial processes, installations or the transport sector. The energy consumption data should be up-to-date, measured and comprehensible. The most important saving opportunities (EEM) must be described and should be calculated according to a long-term life-cycle cost analysis (LCCA) instead of a simple payback calculation.

It is to be noted that the EED does not specify any general standards for carrying out energy audits or for the certification of energy management systems.

Comparison of the target groups for the energy audits

When comparing the two economies, the target group for mandatory energy audits is of particular interest. Not only is there fewer companies in Romania overall than in Germany, but also the national ratio of non-SME is lower at 0.3% of companies (Table 1).

Table 1. Analysis of the number of enterprises by enterprise size class, non-financial business economy

	DE	RO
Population 2019 (Eurostat TPS00002)	83,0 Mio	19,4 Mio
No. of enterprises (thousands)	2.464.008	482.455
Large companies (non-SME)	11.379	1.664
Share	0,5%	0,3%
Persons employed (all)	28.953.220	4.103.059
Persons employed (non-SME)	10.651.385	1.402.445
Share	36,8%	34,2%

Data sources (Commission, 2018a), (Commission, 2018b)

The data sources for table 1 provide estimates for 2017, based on Eurostat data for the years 2008-2015, showing the "non-financial business economy", which includes industry, construction, trade and services. It does not include enterprises in agriculture, forestry, fisheries and the largely non-market services sectors such as education and health. Further comparative statistics on enterprises can be found for instance in (Commission, 2011).

Table 2. Country comparison, main energy figures and indicators

	DE	RO
Energy production [Mtoe]	116,3	25,5
Gross inland consumption [Mtoe]	322,2	33,4
Primary energy consumption 2020-2030 [Mtoe]	298,3	32,4
Final energy consumption 2020-2030 [Mtoe]	218,7	23,2
Primary energy intensity 2020-2030 [toe/M€'10]	102	199
Energy intensity [GAE/GDP2010]- toe/M€'10	111	206
Energy per capita [GIC/pop] - kgoe/cap	3.904	1.703
Final electricity per capita – kWh/cap	6.289	2.275

Data source: (Commission, 2019a)

Table 2 shows the most important energy-related data and indicators for the two countries (Commission, 2019a). Rows 3, 4 and 5 refer to the 2020 - 2030 targets. Final energy consumption is the consumption by end users. Gross energy consumption also includes consumption by the energy sector itself; distribution and transformation losses and 'statistical differences' (not already captured in the figures on primary energy consumption and final energy consumption). For energy intensity, the ratio of gross available energy (GAE) to gross domestic product (GDP) is used (Commission, 2019b).

The figures presented do not answer the question of the number of audits that must be carried out. More information is needed for this:

- 1) The ratio of the number of branches of domestic/foreign subsidiaries of multinational companies.
- 2) The share of companies that have a certified management system and are therefore exempt from the audit requirement. In an empirical study from 2017 on mandatory energy audits in Germany, 462 (52%) of 900 companies surveyed carried out an

- audit, while 403 companies had introduced a management system (Michael Mai, 2017).
- 3) The (average) number of sites of a company for each of which an audit is to be conducted. Depending on the type, a large company may have very few locations for production and sales or a high number of locations such as chain stores. The study (Michael Mai, 2017) reports an average of 34 sites per company with an audit carried out or an average of 24 sites per company with a management system.
 - 4) The number of sites of a company which, due to special case regulations such as trivial limits and multi-site representatives, do not have to conduct their own energy audit within the group of companies.

For these four factors, no reliable figures could be researched to compare the two countries. No statement can be made for the first factor, this requires an investigation of further countries. According to (Michael Mai, 2017), the second factor halves the number of companies, while the third factor multiplies this proportion again by a factor of 34. The fourth factor again has a reducing effect. Combining this study with the figures from Eurostat on large companies we arrive at an estimate of $11.279 \times 50\%$ (have management system) $\times 34$ (avrg # of sites) = 193.443 energy audits in Germany and analogously 28.288 energy audits in Romania. From these values, however, all locations that are not obligated due to multi-site regulations must still be subtracted.

In (Hirzel, 2016), p.201 an estimate of the target groups of 50.000 companies in Germany and 1.500 companies in Malta is mentioned whereby these data refer to the respective national action plans. It is not clear whether these figures apply to large companies or individual sites of large companies. This study also makes it clear that a reliable estimate of the number of companies subject to audit is not possible due to a lack of data. Since in Germany there is an obligation for every company to register from 2019, better data can be expected in the future. Regarding the number of auditors, the German national plan on energy efficiency from 2017 (BAFA, 2017) notes 3.760 auditors are certified who work for one of the 2.659 approved and listed companies or are freelancers. This report estimates the total number of audits of SME and non-SME at 60.000.

In Romania, the annual report on the progress archiving the national energy efficiency target ((ANRE), 2019a) delivers more precise figures: At the end of 2018, there had been certified: 413 energy managers, 176 energy auditors as natural persons, 60 energy auditors as legal entities. According to this report (p 61), 330 energy audits were carried out and a total energy saving potential of 332.070 toe was recorded in 1.500 EEM. Since the existence of the audit obligation, a total of 1.323 energy audits have been carried out between 2015 and 2018, which gives an indication of the total number of companies subject to audit obligations.

Comparison of the national, legal transposition of the EED

The national regulations on energy audit obligations in Germany

In Germany, the EED was introduced through the Gesetze über Energiedienstleistungen und anderen Energieeffizienzmaßnahmen (EDL-G) (Bundestag, 2019), and the amendment of the EDL-G of 6 March 2015 introduced the audit obligation in Germany. This law requires all large companies to carry out a comprehensive energy audit for the first time by 5 December 2015 and thereafter every four years for all company divisions and locations. This obligation applies to all sectors and branches of the economy regardless of any energy and electricity tax relief.

The EDL-G concretizes the EED in essential points: §8 regulates the target group, to which in principle all non-SMEs belong, except companies with a certified energy or environmental management system have established. Since 2019, companies with a total energy consumption of less than 500.000 kWh per year across all energy sources are also exempt from the obligation. In §8a, the EDL-G concretizes the requirements of the EED by the regulation to observe the standard EN 16247-1 (16247-1:2012, 2012) when preparing the energy audits. EDL-G §8b concretizes the requirements for the performing auditor, here professional qualifications and knowledge such as at least three years of professional activity, during which practical knowledge of commercial energy consulting was acquired. EDL-G §8c is dedicated to the proof. Whereas in the first years the audits were only inspected on the basis of spot checks, as of 2019 from 2019 every company must submit a declaration on the audit carried out to the Federal Office of Economics and Export Control (Bundesamt für Wirtschaft und Ausfuhrkontrolle, BAFA).

Since the requirements of the standard DIN EN 16247-1 are relatively concise, the BAFA has published a comprehensive guideline in 2019 (BAFA, 2019a), which specifies many aspects of the audit report to be prepared and formulates minimum criteria for quality and completeness. In addition to the EDL-G, additional instruction sheets have been in existence since 2015, which explain practical compliance with the law by means of examples and more specific details. The following instruction sheets are available in 2019:

- The instruction sheet for Energy Audits (BAFA, 2019b) describes the addressees of the audit requirement, the practical implementation of the energy audit, the requirements for the energy auditor, the procedure for reporting and verification, the provision of evidence and the regulations on fines. This sheet also deals in detail with the auditing of multi-site companies and corporate groups.
- The instruction sheet for the determination of the total energy consumption (BAFA, 2019c), according to these guidelines, the total energy consumption of a company must be determined for a period of 12 months. Here, for example, all energy sources to be considered are listed and there will be examples of how to handle asynchronous billing periods.
- There are further instruction sheets, e.g. on the verification of the SME status or on requirements for energy consultants to be admitted as auditors.

Figure 1 illustrates the interrelationships of all legal requirements and in particular the role of the European standard EN 16247-1 for energy audits. The ISO 50002 standard for energy audits (Standardization, 2014), which has existed since 2014 and differs only very slightly from EN 16247-1, is not mentioned in either country's legal text.

Figure 1: National transposition of the EED in Romania and Germany.

Source: authors

The national regulations on energy audit obligations in Romania

In Romania, the national transposition of the EED took place in law no 121/2014 on energy efficiency, published in the Official Gazette of Romania, Part I No 574 of 1st August 2014 (României, 2014). The law was extended by an amendment by law no 160/2016, published in Official Gazette of Romania No 562/26 of July 26th 2016 (României, 2016). In Romania, too, the level of detail of the law is aligned on the description of Article 8, so that here, as well, concretizations have been supplemented by guidelines and instruction sheets:

- ANRE Decision 2794 ((ANRE), 2014a), regulates the certification of the energy managers and the approval of the companies providing energy services and of the Regulation for the authorization of the energy auditors in the industry.
- ANRE Decision 1111 ((ANRE), 2017), published in Official Gazette of Romania 655/09.08.2017, extends and modifies Decision 2794.
- The Annex of ANRE Decision 2123 ((ANRE), 2014b) from 2014 contains a detailed guideline on how to conduct the energy audit and prepare the audit report including minimum criteria for energy audits.
- ANRE Decision 1685 ((ANRE), 2019b), published in Official Gazette of Romania 788/29.09.2019, regards the verifying compliance with the minimum criteria when developing energy audits
- ANRE Decision 366 ((ANRE), 2019c) published in Official Gazette of Romania 185/07.03.2019 regards the approval of the models for the declaration of total annual energy consumption and for the energy analysis questionnaire of the energy consumer

A brief overview about the legislative framework in Romania related to the EED can be found in ((ANRE), 2019d).

The most comprehensive specifications for the audits themselves are provided by ANRE Decision 2794, which is based on the standard SR EN 16247-1-2013 and also refers to other guidelines such as ANRE 2123/2014. In this guideline different classes and types of audits are defined as shown in Table 3. The classes differ according to the power installed on the energy audit outline (P_i), the types divide the audits into electrical, thermal or complex audits. Class II audits may only be performed by auditors as legal entities with higher approval criteria, while Class I audits may be performed by natural persons. The requirements for certification and qualification of auditors are also defined in ANRE 2794. The Annex contains the forms for the mandatory reports on the energy audits performed.

Table 3: Classes and types of energy audits in Romania.

	Electric power audit	Thermal power audit	Complex audit
Class I	$P_i \leq 1.000 \text{ kW}$	$P_i \leq 2.000 \text{ kW}$	$P_i \leq 3.000 \text{ kW}$
Class II	$P_i > 1.000 \text{ kW}$	$P_i > 2.000 \text{ kW}$	unlimited

Data source: ((ANRE), 2014a)

The amendment ANRE 1111 introduces an additional evaluation form to assess the quality of the audit performed according to a points system. In addition to the typification, the business field is also specified here, whereby a distinction is only made between industry, transport or services. The evaluation form is also to be submitted for companies that are below the de minimis threshold of 1.000 toe.

Table 4: Comparison table on the audit regulations of Germany and Romania

	DE	RO
Name of law	Gesetze über Energiedienstleistungen und anderen Energieeffizienzmaßnahmen (EDL-G) with amendment 2019	Law no. 121/2014 amended by law 160/2016
Executive authority	Bundesamtes für Wirtschaft und Ausfuhrkontrolle (BAFA)	Autoritatea Nationala de Reglementare în domeniul Energiei (ANRE)
Definition “large companies”	Comply with EU definition	Comply with EU definition
Exemptions	<ul style="list-style-type: none"> Municipalities and bodies with predominantly sovereign functions Certified management system installed (ISO 50001 or EMAS) de minimis limit : 500.000 kWh p.a. (approx. 43 toe) 	<ul style="list-style-type: none"> Certified management system installed (ISO 50001 or ISO 14001:2005) de minimis limit: 1.000 toe p.a. (approx. 11.630.000 kWh)
Penalty for non-compliance	Up to 50.000 €	Up to 200.000 Lei ($\approx$ 40.000 €)
Different audit types and classes	No	Yes (two classes by quantity, three types by dominant energy carrier)
Minimum coverage of energy audit	Minimum share of consumption: 90%	Minimum share of consumption: 50%
Active reporting on the execution of	Yes (since 2019)	Yes (since 2016)

the audit required?		
Multi-Site procedures	Thresholds at group level.	(n/a)
Sampling approach allowed	Yes	(n/a)
Rules for the qualification of the auditor?	Yes	Yes
Distinction between auditor as a natural and as a legal person?	No	Yes
Rules for determining total energy consumption?	Guideline since 2019 (BAFA, 2019c)	Yes, guideline including templates
Rules for the structure of the audit report	Partially (based on DIN EN 16247-1)	(n/a)
Rules on determination of measured consumption values	Yes, it should be measured. Just in special cases estimates and extrapolations are allowed.	(n/a)
Rules on the allocation of energy consumption.	Yes	(n/a)
Load profiles required?	Yes	(n/a)
Key indicators required?	Yes	Yes
Are there requirements for the calculation of the EEM?	Yes. Calculations must be done very extensive and should be based on a net present value calculation including discounting. A simple payback period is not sufficient.	Yes. Calculations have to be done very extensive and should be based on a net present value calculation including discounting.
Rating template	No	Yes (for evaluation of audit quality)

Sources: ((ANRE), 2014a, 2014b, 2017, 2019b, 2019c; BAFA, 2019a, 2019b, 2019c, 2019d)

Table 4 shows a comparison of the legal requirements for energy audits in the two countries. Some aspects that seem relevant for the performance or quality assurance of the audits are compared here. The aspect on multi-site procedures examines the existence of special regulations for companies with many sites. In the case of a large number of similar sites, such as sales branches, a sampling approach may be permissible, which reduces the auditing of the entire company to the auditing of a small number of representative sites. For entries with (n/a) the authors could not find any clear regulation in the legal sources.

Results

There are relatively few differences in the transposition of Article 8 of the EED into national legislation, as the laws passed by parliament almost retain the wording and scope of the EED and do not contain any details for implementation. The European Standard EN 16247-1 for audits is only explicitly mentioned in the German EDL-G. The specifications that are significant for companies are then supplemented in extra-parliamentary provisions. These specifications are mainly used to define exemptions from the obligation, but also in particular to ensure the quality of the audits carried out and the qualification of the auditors. After the first deadline in December 2015 for conducting the audits in both countries, these extra-parliamentary provisions were extended and supplemented several times. In Romania, EN 16247-1 is taken as a basis in the guidelines. It is remarkable to note that the successor standard ISO 50002 is not mentioned in either country so far. Also worth mentioning is the extension of the EED provisions on subsidised

audits, which provides very detailed concretizations and examples of energy efficiency calculations in the Annex of (EuropeanParliament, 2018b), while Article 8 provides no further concretizations.

The audit obligation affects considerably more companies in Germany than in Romania. This is not only due to the higher number of non-SME, but also to the significantly lower de minimis threshold for exceptions. At 500 MWh per year, German companies have a much lower limit than Romanian companies, which only have to carry out an audit from 11.630 MWh per year. While in Romania, every company had to submit a declaration on energy consumption and the audit performed already in the first audit period, this reporting obligation was not introduced in Germany until 2019. This will result in better figures in the future for the national total number of audits, which is currently only estimated. Figures on the real number of fines and their amount are not available for either country.

In the provisions and guidelines for conducting audits, a number of factors can be identified which have a significant influence on audit quality. The minimum coverage of consumers in the audit must be 90 percent of the total energy used in Germany, whereas in Romania only half of the consumers of a company must be examined or measured. This reduction allows a focus on the energy-intensive parts of the company and reduces the costs of the audit. A classification of audits only exists in Romania, where companies are classified according to the size and nature of consumption (eclectic, thermal or complex). The requirements for the qualification of the auditors are aligned to this classification. Another peculiarity in Romania is an evaluation scheme for conducting the audit, which is reminiscent of evaluation classes for conducting financial audits and supports subsequent, nationwide evaluation.

Conclusion

This comparative study examines the national implementation of the EED requirement for mandatory energy audits in Romania and Germany. The European directive has been implemented in both member states since 2015. While the national laws are mostly limited to adopting the wording of the EED, numerous supplementary guidelines and provisions have been published to further concretize and regulate the EED. In both countries, a learning process can be seen on the part of the government in dealing with the new instrument "mandatory audit", as numerous guidelines and instructions were amended and extended after the first deadline in 2015. The problem of determining the total number of mandatory audits in Germany will be solved in the future, as from 2020 every company in Germany will also have to actively submit a report on the energy audit carried out or the reasons for exemption. Our hypothesis regarding the equality of the implementation of mandatory audits must be rejected, as there are significant differences in the requirements. The two most significant factors are the minimum consumption for exemptions and the coverage of the total consumption within the audit. With regard to the mandatory energy audits, this results in a location disadvantage for companies in Germany.

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