Methodical approach to assessing the energy efficiency class of an industrial facility based on an expert opinion

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Funding: The reported study was funded by RFBR, project number 20-010-00754

Abstract. The article examines an expert survey as the effective way to obtain information which is necessary to form a unified statistical information base of industrial facilities in terms of their energy efficiency. The conceptual model for developing a methodology for the expert survey of leading Russian and world experts in the field of energy efficiency and energy saving is presented. The model reflects the main elements which should be taken into account when conducting it. The toolkit for conducting the survey is proposed, which determines the basis for the classification of industrial facilities according to their level of energy efficiency. The analysis of expert opinions will make it possible to draw unambiguous conclusions to the overall opinion issues of the study and reach a consensus on its key problems.

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1. Introduction

Nowadays, the issues of energy consumption optimization are given considerable attention at all the levels of the executive and legislative power of the Russian Federation; they are reflected in various forms of economic and energy foresights. As it is noted in the Energy Strategy 2035 draft: „The development of energy saving and energy efficiency in the energy consuming sectors is one of the key scenario conditions in predicting the prospects for the development of the fuel and energy complex” [1].

The important scientific problem that hinders the implementation of state policy in the field of energy conservation and energy efficiency is the lack of the required amount of reliable information on the energy efficiency of the industrial facilities, methods and criteria for their systematization. To solve the set state tasks aimed at reducing the energy intensity of the national economy, it is necessary to create Unified Information Statistical Database of industrial facilities (UISD) based on their identification and classification, taking into account the types of economic activities according to the groups of the All-Russian Classifier of Economic Activities (OKVED) [2].

Forming of the UISD will be a prerequisite for the implementation of the measures to ensure energy efficiency policies of the industrial enterprises.

When forming the UISD, the most important monitoring elements are information on the energy consumption and energy-saving measures taken at the industrial enterprises. Since 2019, the mandatory energy survey has been removed from Russian legislation, it prevents the receipt of information and the completion of the UISD. It means that at present it is required to develop the tools for monitoring the energy consumption of the industrial enterprises promptly. Conducting the survey of the industrial enterprises in order to obtain reliable information on the energy consumption of the
industrial enterprises, the carried out energy-saving measures, as well as identifying the problems that prevent the realization of the potential to reduce energy consumption costs. It is necessary to develop questionnaires and to form a methodology for conducting the survey of the industrial enterprises to enter information on their energy costs in the UISD. The development of the tools and methods for conducting the survey should be objective and consistent with expert opinion. Thus, the forerunner of the survey of the industrial enterprises is the survey of experts on the subject of the study, which makes it possible to ensure the objectivity of the survey of the industrial enterprises and forming of the UISD.

Within the framework of this study, the methodological aspects of conducting the expert survey are considered as the effective way of obtaining information necessary for forming of energy efficiency classes of the industrial facilities.

The object of the research is industrial enterprises, they are manufacturers of the domestic products, registered in the state industry information base (GISP).

As a subject that determines the problem area of research, it is necessary to single out the process of creating the methodology for polling industrial enterprises to obtain information on energy costs, energy activities, as well as identifying the problems at the industrial enterprises.

The research problem is the lack of information on the assessment of the energy efficiency of the industrial facilities in the scientific Russian and foreign literature.

The aim of the study is to develop the toolkit for conducting the expert survey, which forms the basis for classifying the industrial facilities by the level of their energy efficiency and the methodology for conducting the survey of the leading Russian and world experts in the energy consumption and energy conservation.

Achieving this goal is possible by solving the following tasks:

• to develop the methodology for conducting the expert survey;
• to give a meaningful description of the stages of the expert survey;
• to develop the tools for conducting the survey;
• to give recommendations for the development of the methodology for conducting the survey of the industrial enterprises.

The relevance of the study is also confirmed by the multiplicity of the indirect factors in the development of the system for monitoring the energy efficiency of the industrial facilities, which provide the motivation for many stakeholders. One of the conditions for ensuring the country’s socio-economic development is to increase the competitiveness of the products of the various industries, industrial complexes and individual enterprises. The competitiveness of the industrial enterprises is largely determined by the energy intensity of the manufactured products and the degree of resource use efficiency. Thus, energy saving management and rational energy use is the important factor in increasing the competitiveness of Russian economy and meeting the requirements of the international environmental standards in the market conditions.

Russian economic community is actively working at the theoretical issues in the field of energy conservation and energy efficiency, as well as recommendations based on the scientific analysis of modern practices. The degree of development of the research theme is due to the presence of many works of Russian and foreign scientists, many of which belong to the academic community.

There are extensive discussions in the scientific community, there are different positions on the advisability of conducting the expert survey, on its recognition as a scientific method for analyzing complex non-formalized problems. Much attention is paid to the various aspects of conducting the expert survey in the modern literature. The researchers dealing with this issue are Karasev O., Mukanina E. [3], Gorskikh M., Sheregi F. [4], Gutsykova S. [5], Liaskovskiy V., Smirnov S., Pronin A. [6], Chernysheva T. [7], Maslennikov E. [8], Kukushkina S. [9], Sidelnikov Yu. [10], Kitaev A., Mironova I., Shinkarenko T. [11], Kuzmenko T. [12].
The expert survey and expert analysis methods are widely used to solve the problems in the energy sector at the global level. The experts explore the role of the technological innovations in Germany’s energy transition [13]. The multi-criteria study with European experts was conducted concerning the digital energy services which improve energy efficiency [14]. In order to improve long-term forecasts for energy carriers in such countries as Australia, Indonesia, Malaysia and Thailand, the method of expert estimates is used [15]. In addition, in order to contribute to the development of the social indicators for assessing the impact of energy systems on the society, a set of social the indicators was developed based on the opinions of European experts drawn from France, Germany, Italy and Switzerland [16].

Despite the existing degree of working out the research theme, the nature of the work indicates discreteness in the study of the most pressing problems. Nowadays, there are some methodological developments in the Russian Federation. It should be noted the developed Methodology for determining the energy efficiency class of the residential apartment buildings [17]. At the same time, there is no methodological toolkit now which can be used as the basis for the classification by the level of energy efficiency of the most energy-intensive economic entities (industrial facilities). The modern conditions are characterized by complexity, insufficient completeness of information when conducting this kind of research.

The solution of this problem is possible by applying the method of expert survey, aimed at obtaining the deep detailed information about the subject of research from the competent specialists in the field of energy saving and increasing energy efficiency; it will facilitate the interpretation of the analytical data obtained to formulate hypotheses and productive ideas which are necessary for developing the methodology of the industrial enterprises survey.

2. Materials and methods

The main method of obtaining empirical information is a survey of experts, both formalized (filling out a closed questionnaire) and semi-formalized (individual interviews on the issues raised in the questionnaire) in this study.

The expert survey is supposed to be carried out in order to obtain information on the indicators and factors which should be taken into account when assessing the energy efficiency class of the industrial facility, as well as other information which is necessary to develop the tools and methods for conducting a survey of managers and proxies or competent representatives from the industrial enterprises.

The subjects of the expert survey are representatives of the professional standardization communities, energy auditors (persons entitled to conduct an energy survey on behalf of the individual entrepreneur or organization which is a part of the self-regulatory organization in the field of energy survey), independent experts in the field under study, representatives of industry associations, international organizations in the field of energy.

Based on the experts’ judgment, the following tasks are expected to be solved during the survey:

- to identify the problems associated with the development of methodology for polling industrial enterprises;
- to determine the list of questions to be included in the questionnaire of the industrial enterprises;
- to generate the new ideas concerning the development of methodology for polling industrial enterprises;
- to estimate decisions concerning the development of methodology for interviewing industrial enterprises.

For the study the hypothesis was put forward; the essence of it is the following. Conducting a survey of experts in the field of energy efficiency of the industrial facilities will take into account the views of stakeholders when developing a survey toolkit for the representatives of the industrial enterprises, which will improve the quality of the study and develop the effective survey toolkit.
The researches of the energy efficiency issues are limited in the field of industry; therefore, the experts with the sufficient level of knowledge in the general direction of the subject area of research were involved. The final sample of experts was selected according to the following criteria:

- the presence of at least 3 published scientific works on the theme corresponding to the direction of research in the form of monographs or articles;
- at least 3 years of teaching / expert or other professional activity related to the subject area of the study, confirming the professional competence of the expert.

When planning the sample size, the minimum total number of experts required to conduct the expert survey is 10 people. In view of the fact that at this time, both in the Russian Federation and at the world level, there are no scientific and practical developments on the research theme, this number of respondents is considered to be sufficient and reasonable. The final sample is planned to be formed on the basis of experts who meet the set selection criteria.

3. Results
Based on the research results, the main elements of the concept were identified; they should be taken into account when conducting the expert survey of the leading world and Russian experts in the field of energy efficiency; the elements are presented in the form of the model reflecting their relationship and sequence (Figure 1).
Figure 1. The concept of developing of the expert survey methodology for assessing energy efficiency classes of the industrial facilities
It was proposed to use a questionnaire and an interview script as the main tool for conducting the survey. The questionnaire has got a strict structure and consists of two semantic blocks. The content of the first block includes the general questions to collect quality data about the experts. This block contains brief information about the expert: the country he represents, the region, the name and type of activity of the company in which he works, the name and surname of the expert, his position, e-mail, as well as his interest in receiving information about the results of the survey. The questions in this block are mostly open-ended.

The second block includes directly the questions within the research theme aimed at obtaining information which allows you to identify the most significant aspects that should be considered when developing a methodology for interviewing managers and proxies or competent representatives from the industrial enterprises.

The questions in this block will allow you to reflect information about:

- the impact of industrial energy efficiency on the level of the country’s economy, the expert is a representative of this country;
- the consolidation of the „industrial facility” concept in the expert’s country;
- the current system for assessing energy efficiency classes of the industrial facilities in the country, which is represented by the expert;
- the possibility of using the single methodology for assessing energy efficiency classes, based on the universal principles, for the industrial, residential, public and other types of facilities;
- the sufficiency of the data given in the energy passports of facilities to assess the energy efficiency classes of the industrial facilities;
- the status of „voluntariness” of the classification of the industrial facilities by the level of energy efficiency;
- the status of „voluntariness” of the energy survey for all the objects of production or non-production purpose;
- the need to create a register of the industrial facilities for energy-intensive activities for the mandatory assessment of their energy efficiency class;
- the feasibility of creating a single international methodology for assessing energy efficiency classes of the industrial facilities;
- the content of the „industrial facility” term;
- the factors and indicators which must necessarily be taken into account when assessing the energy efficiency class of the industrial facility.

The questions of the specialized block are mandatory, it will allow receiving answers from the respondents to absolutely all the questions presented in it. This fact will contribute to obtaining basic information about the key research questions.

Due to the fact that in the modern conditions the online survey is one of the most convenient methods for conducting the surveys, the questionnaire will be compiled in the application for administering surveys; it’s Google Forms, which is an online service for creating the feedback forms, online tests and surveys.

Conducting the survey involves sending a link to the electronic questionnaire to the potential respondents via the Internet, according to the list of experts participating in the survey. It is planned to involve Russian experts in the field of energy conservation and energy efficiency for the interview. Questions for the individual interview are developed on the basis of the questionnaire questions and are predominantly open-ended; it will allow obtaining more detailed information about the research theme from the respondent.
4. Discussions
The opinions of the leading world and Russian experts will make it possible to draw unambiguous conclusions on the controversial issues of the study and to reach a consensus on its key problems. This survey will make it possible to find a solution concerning the interpretation of the „industrial facility” term, to determine the factors and indicators which must be taken into account when assessing the energy efficiency class of the industrial facility and also to get answers for the other equally important questions according to the research theme. The results of the expert survey and the resulting basis for forming the system of energy efficiency classes of the industrial facilities will contribute to the possibility of developing the tools and methods for conducting a survey of managers and proxies or competent representatives from the industrial enterprises. In turn, the obtained results of the survey of the industrial enterprises according to the energy consumption, ongoing energy measures, recorded in the SISB, will contribute to its reasonable forming as a tool for monitoring energy consumption of the industrial enterprises.

5. Conclusions
As a result of the study, which involves the consideration of the methodological provisions of the expert survey of the leading Russian and world experts in the field of energy consumption and energy saving, the following conclusions can be drawn:
- the effective and practical way to obtain information which is necessary for energy efficiency classes of the industrial facilities forming is an expert survey;
- the identified problem according to the research theme and approaches to its solution, presented in the logical decomposition, made it possible to form the concept of developing the expert survey methodology for assessing energy efficiency classes of the industrial facilities, based on Deming-Shewhart continuous improvement cycle;
- as a toolkit for conducting an expert survey, it is proposed to use a questionnaire and an interview script on questions requiring specification and a detailed answer on the research topic.

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Acknowledgments: The reported study was funded by RFBR, project number 20-010-00754.