Risk insurance cost estimation using the example of a transport company energy saving project

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Abstract. The main activity of energy service companies is possible with a flexible risk management system, which should be based on the implementation of certain principles. In this article, the authors propose their own set of principles, among which insurance occupies an important place. By property insuring, in case of its complete destruction, compensation can be obtained that allows to fully recover the costs incurred when purchasing energy-saving equipment. So, in the article, a business case is given for equipment insurance for a transport company based on scenario modeling.

1. Introduction

Energy service companies are called upon to implement the most important task of introducing and developing energy saving systems at Russian enterprises, obliged to finance energy-saving projects at their own expense in order to extract future revenues by saving energy at customer sites. The relevance of the appearance of these market participants in the energy sector is confirmed by the urgent need to implement the activities of state program “Energy Efficiency and Energy Development”, which is approved in 2014, but has not been fully implemented to this day.

In unstable conditions of market development, associated with an increase in electricity tariffs, increasing environmental risks, insufficient financial resources for business entities, one of the most important activities of energy service companies is risk management.

Risks of energy service companies are diverse: property, business, liability risks, specific risks associated with energy saving projects and inherent only to the activities of energy service companies. So, risks associated with fulfilling the terms of an energy service contract often arise for following reasons:
- long term implementation of the project on energy conservation;
- large number of tools and methods of energy saving;
- high qualification requirements for employees of energy service company;
- increased attention to the level of responsibility of customers operating energy-saving equipment throughout the entire period of contract.

Lack of many years of successful experience in implementing energy saving projects and establishment of energy service industry in Russia leads to the need to pay special attention to risk management in energy service companies.

Issues related to enterprise risk insurance were considered in works of such scientists as B.Kh. Aliev, Yu.M. Makhdieva, A.P. Arkhipov, I.T. Balabanov, V. B. Gomell, N. B. Grishchenko, S. V. Ermasov, N. B. Ermasova, A. G. Ivasenko, Ya. I. Nikonova, L. A. Orlyuk-Malitsky, S. Yu. Yanova,
B. A. Raizberg, L. Sh. Lozovsky, E. B. Starodubtseva, L. G. Skamay, Yu. A. Sletukhov, E.F. Dyuzhikov, A.I. Khudyakov, G.V. Chernova, V.V. Shakhov, A.S. Shapkin, V.A. Shapkin, A.K. Shikhov and many others [1-3,5,6].

The main foreign sources for solving energy service problems and company risk management are: a study by M. Didushkova, M. Votapek “Energy Performance Contracting”; study “Energy Contracting. Successful energy services business models”, prepared by the European Association of Energy Service Companies; non-European countries energy service market report “ESCO Market report for Non-European countries 2013”, prepared by S. Panev, N. Labanca, P. Bertoldi, “Energy Performance Contracts Guidelines” by K. Kilber [4,8].

One of the most effective risk management methods for energy service companies is insurance. Currently, energy service companies in Russia use both traditional insurance products to manage energy saving risks and specialized insurance products that take into account specifics of this industry. So, using a specialized insurance product, an energy service company can insure property purchased under the project and installed at the customer’s facilities; insure against interruptions in customer’s production activities related to property damage; financial risks; weather risks. As part of this product, technical risk insurance, insurance of machinery and equipment, insurance of electronic devices, etc. can be taken into account. However, this product for energy service companies is not without drawbacks. It does not imply liability insurance, although any energy saving project carries risks of liability to the customer’s employees or personnel of the energy service company, as well as risks of liability to third parties. Responsibility to these categories of persons along with property risks should be insured.

In this regard, most energy service companies choose risk insurance using a set of insurance coverings for various types of insurance. In this case, energy service company can insure risks in different insurance companies or choose an insurance package in one company, but for different insurance products. Traditionally, the most complete service can be provided by large companies with many years of experience [7].

At the same time, risks of energy service companies from the point of view of insurers can be represented as a combination of property risks, liability risks, business and financial risks. It is important to choose most optimal insurance products that will be taken into account in the risk management system of energy service company. To do this, it is advisable to determine most accurately the purpose, principles and components of risk management system of this company.

2. Methods

Given the significant number of risks of energy service activities, it is logical to assume that in order to successfully implement projects and eliminate the need for guarantee payments, energy service company should build a risk management system. The main goal for the company is to increase the likelihood of implementing energy saving projects with the achievement of planned profit through effective risk management. This goal is achieved through: rejection of high-risk projects; risk assessment and management in ongoing projects; monitoring external risks in relation to the energy saving project; formation of reasonable and sufficient insurance coverage of risks in projects; creating a risk register; training and motivation of customer personnel on careful use of energy-saving equipment.

Figure 1 shows proposed risk management system in energy service company, taking into account principles discussed above.
Figure 1. The proposed risk management system in energy service company.

Management and risk managements department in the company are subjects of management and form the purpose of the system, its principles. Also, risk managers choose methods for risk assessing and managing to affect management object (risks of energy saving project). So, when assessing risks of energy saving projects, the most widely used methods are: sensitivity analysis, critical points calculation method, scenario method, Monte Carlo method, event tree construction method [9]. When risk managing in Russian practice, it is effective to use methods such as: risk aversion, risk reduction, risk dissipation, risk compensation.

The result of this system is to reduce project risks and damage from them.

In case of failure to achieve the planned result, the subject of management reviews composition of instruments of influence, and if it is impossible to achieve the purpose of management, the purpose itself is reviewed.

It is important to take into account specifics of activities of energy companies in formation and development of a risk management system. In this case, it is advisable to determine a set of principles that it will have to comply with (Figure 2).

Figure 2. Principles of risk management system of an energy service company.
Following these principles will allow to build an effective risk management system.

1. As part of their activities, Russian energy service companies may take into account a specific set of risks in each specific situation. Thus, the principle of “Boundaries of the zone of influence” suggests that since the functionality and capabilities of risk managers of energy service company are limited in energy saving projects, their risk analysis should provide management with information on those projects where risks beyond the control are unacceptably high, therefore, only those projects in which risks are manageable should be accepted for implementation. In addition, risk management process itself is limited to actions within the framework of projects, otherwise the risk management costs will exceed expected effect of the project.

2. The principle of "maximum staff involvement." Each employee in the organization is included in risk management system, only with the caveat that risk management department is a kind of analytical center for risk management decisions; management of energy service company is responsible for making managerial decisions in the field of risks, mainly based on the information that risk management department provides; other employees are both sources of risk information and local risk managers.

3. The principle of “flexibility of risk management system” means that all elements of the system, in particular the number of employees in risk management department, are transformed under the influence of changes in factors of external and internal environment. With a small annual financial turnover of energy service company, risk management department may consist of two to three employees sharing all the necessary functions. If energy service company has a significant financial turnover (more than $ 5 million per year) and implements several dozen projects at the same time, then several employees must perform several functions in the risk management system at once.

4. Implementation of the principle of “continuous monitoring of risks” implies that after preventive measures and other managerial impacts on risks, risk management system of energy service company should continue to assess these risks (it is advisable to establish a certain frequency of such assessments, for example, weekly, once a month, once a quarter), as managerial actions performed may not be enough to completely eliminate the identified threats. At the same time, it is necessary to make sure that customers are not exposed to new external risks, and that they do not generate additional risks throughout the project implementation period.

5. The principle of “taking into account long-term factors” implies that energy service company operates continuously and implements each performance contract for 3-5 years. Over this period of time, the increase in electricity prices laid down in the project may not correspond to the real dynamics of tariffs, in addition, legislation in the field of energy saving may change, customer performance indicators may worsen, and many other risks external to the project will arise. When planning the activities of an energy service company, these risks must also be taken into account.

6. The principle of “mandatory use of insurance” is implemented in company's risk management system, rather, as a response to the situation that has developed in the energy service market, in which many energy service companies refuse insurance in favor of higher risks and higher margins. At the same time, two arguments in favor of insurance are indisputable. Firstly, implementation of energy saving projects is associated with many critical risks. Secondly, in most developed countries where energy services have been used for many years, insurance of energy saving projects is a wide practice for private customers' projects, and a prerequisite for government projects.

3. Results
In order to test the proposed recommendations, an economic feasibility study of alternative methods of risk insurance for energy service company was conducted for the energy saving project commissioned by the transport company.

Effective use of insurance, as one of the risk management methods in energy saving projects, is possible only if risk managers of energy service company change their approaches to the formation of insurance coverage for energy saving projects. Insurance coverage should include a realistic set of risks and pre-represent damage to the organization, taking into account which, as well as insurance
costs, one can calculate the profitability of the project. The amount of costs for insurance of project risks should be determined using scenario modeling, i.e., selecting insurance products according to the most probable scenarios for implementing project risks. It is proposed to single out scenarios that include insurance only for highly probable risks, risks with a high and medium probability of implementation in this project, and a scenario that includes all insured risks of the project.

To justify the feasibility of insuring the risks of energy service company and formation of insurance coverage based on the scenarios, the amount of insurance premiums to be paid by the energy service company is determined. Calculations were made on the basis of real insurance products and insurance rates of a large Russian insurance company. When choosing an insurance company as a reference, following criteria were presented: experience in the insurance industry for more than 30 years, international professional activity, insurance of a wide range of risks, including those taken into account by energy service companies.

For further calculations of total cost of insurance according to the selected scenarios, following conditional source data of energy saving project were adopted:

1) Transport company A - customer of the project;
2) Energy service company B - project executor;
3) Project duration - 5 years;
4) 235.2 thousand dollars - total cost of equipment purchased, providing energy saving for this project;
5) 37.1 thousand dollars - cost of construction works;
6) 18.5 thousand dollars - contingency reserve fund and risk insurance;
7) 45.6 thousand dollars - profit of the energy service company for 5 years;
8) 178.1 thousand dollars - cost of equipment transferred for insurance. According to the energy saving project under consideration, only expensive and significant equipment was transferred for insurance from the standpoint of ensuring the production process (gas piston power station, compressor, privately regulated compressor, inductor heater, gas infrared heaters, etc.).

Total cost of the energy saving project amounted to 336.4 thousand dollars. (Table 1).

| Expenditures                                | Cost, thousand dollars |
|---------------------------------------------|-----------------------|
| Energy saving equipment                     | 235.2                 |
| Construction and installation work          | 37.1                  |
| Contingency reserve fund and risk insurance | 18.5                  |
| Energy Service Company Profit               | 45.6                  |
| Total                                       | 336.4                 |

Table 1. Total cost of the project on energy saving.

All energy saving measures of energy service company were implemented in full. Construction and installation work lasted 3 months, respectively, the operation of equipment and obtaining savings amounted to 4 years and 9 months.

When forming the scenarios, the most probable risks should be considered, according to the conditions in which the project is being implemented:

1) major risks that have appeared at the customer’s site in the past;
2) risks associated with location of customer facilities on the ground, features of the work of energy-saving equipment;
3) possible natural risks.

Table 2 presents risks identified by the methods of quantitative and qualitative assessment of risks of the project on energy saving, and also indicates the degree of danger they pose.
Table 2. Identified risks in the project and their degree of danger.

| Type of risk                                      | Name of risk                                      | Hazard rating |
|--------------------------------------------------|---------------------------------------------------|---------------|
| 1. Responsibility to third parties during construction and installation works | average  | during the project implementation period | low |
| 2. Property risks of external exposure (including natural ones) | fire | high |
| | lightning strike | low |
| | explosion | low |
| | natural disasters | low |
| | theft | average |
| | malicious acts of third parties | average |
| | other risks causing property damage | low |
| | loss of profit | average |
| 3. Property risks of internal exposure (including breakdown of energy-saving equipment) | staff errors | high |
| | energy overload | high |
| | foreign matter clogging | high |
| | “Material fatigue” | high |
| | voltage drop | high |
| | fire | high |
| | other risks causing equipment breakdown | high |
| 4. Other insured risks | absent |

It should be noted that only those risks subject to insurance are included in this table, since the modeling process covers calculation of the cost of insurance coverage, which can include only insured risks. In addition, the degree of danger of each risk (“low”, “average” and “high”) is determined individually by energy service companies based on risk management experience, available financial resources, reserves formed, company capabilities, etc.

After the risks are identified and their degree of danger for the project is determined, scenarios are formed. Risks with high danger fall into the first scenario, which implies compulsory insurance of risks of this scenario, since achieving the planned savings correlates quite strongly with the effectiveness of management, namely these risks. The second scenario includes risks representing an average degree of danger for the project, as well as the risks of the first scenario. The third scenario includes all the insured risks of the project. It is advisable to use it for budgetary institutions, or for high-risk projects, since for these types of projects stability and achieving the planned level of savings are in the first place, and only then the project implementation period and the level of its profitability.

Table 3 presents scenarios based on the risks identified in the draft project and their degree of danger.

Table 3. Insurable risks in the project, according to three risk scenarios.

| Type of risk | Name of risk | Scenario 1 | Scenario 2 | Scenario 3 |
|--------------|--------------|------------|------------|------------|
| 1. Responsibility to third parties during construction and installation works | - | + | + |
| | during the project implementation period | - | - | + |
| 2. Property risks | fire | + | + | + |
| of external exposure | lightning strike | - | - | + |
| (including natural ones) | explosion | - | - | + |
| | natural disasters | - | - | + |
| | theft | - | + | + |
| | malicious acts of third parties | - | + | + |
| | other risks causing property damage | - | - | + |
3. Property risks of internal exposure (including energy-saving equipment)

- staff errors
- energy overload
- foreign matter clogging
- “Material fatigue”
- voltage drop
- fire
- other risks causing equipment breakdown

4. Other insured risks

Next, one need to calculate the cost of insurance coverage for each risk scenario.

Risk scenario insurance costs are recommended to be calculated using the following formula:

\[ R_j = \sum_{i=1}^{n} H_i k_i^H S_i t_i k_i^T, \]

where \( R_j \) - scenario j insurance premium; \( H_i \) - basic insurance rate for the i type of insurance; \( k_i^H \) - correction factor for the i type of insurance; \( S_i \) - insurance amount for the i type of insurance; \( k_i^T \) - reducing coefficient for the insurance period of less than a year, with insurance for a year or more it is equal to 1.

Scenario 1. In this scenario, it is only necessary to transfer new machines to insurance, since damage or destruction of equipment will instantly lead to production stoppage and loss of profit, which will require equipment repair or its urgent replacement. Under this scenario, property risks (“fire”, “equipment breakdown”) are accepted as the main ones.

Scenario 2. Taking into account additional risks that are included in the insurance coverage, it is necessary to insure following risks:

- liability insurance during construction and installation works;
- property insurance against fire, malicious acts of third parties, theft;
- insurance of equipment against breakdowns;
- insurance of loss of profit from interruptions in production.

Scenario 3. According to this scenario, it is assumed insurance of all insured risks of the project:

- liability insurance to third parties for the period of construction and installation works;
- property insurance against a full package of risks (under an insurance contract against all risks, insurer reimburses the insured for damage from loss, destruction or damage of insured property resulting from any sudden and unforeseen impact, or any event that has signs of probability and chance);
- liability insurance to third parties.

Table 4 presents the costs of insurance of risks of energy saving project in the framework of presented scenarios.

### Table 4. Costs of risk insurance of the energy saving project by scenarios.

| Insurance type | Insurance period | Scenario 1 | Scenario 2 | Scenario 3 |
|----------------|------------------|------------|------------|------------|
| Liability insurance during construction and installation works, USD | 3 months | - | 980 | 980 |
| Liability insurance, USD | 1 year | - | - | 315 |
| Property insurance against fire, USD | 1 year | 711.7 | - | - |
| Property insurance against fire, burglary and malicious acts of third parties, USD | 1 year | - | 953.3 | - |
| Property insurance against all risks, USD | 1 year | - | - | 2671.7 |
| Insurance against loss of profits as a result of a | 1 year | - | 214.6 | - |
break in production, USD  
Insurance against breakdowns and personnel errors, USD 
Total cost of insurance under the scenario, USD  
  1 year  851  851  -
  5 years (4 years 9 months)  1562.7  2998.9  3966.7  
Total cost of insurance under the scenario for the entire duration of the project, USD  
Insurance costs of the total project cost, %  
  1 year  2.2  3.2  4.5

4. Conclusions
Thus, it must be emphasized that the main activity of energy service companies is possible with a flexible risk management system, which should be based on the implementation of following principles: limited influence area, maximum staff involvement, mandatory insurance, continuous risk monitoring, taking into account long-term factors, flexibility of risk system -management.

Among the main tools of risk management, it is necessary to use insurance, since it gives the greatest positive effect in risk management. By property insuring, in case of its complete destruction, compensation can be obtained that allows to fully recover the costs incurred when purchasing equipment.

Efficiency of insurance of energy saving projects implemented by an energy service company can be improved by using scenario-based risk modeling. It will allow risk managers to take into account the most likely risks in the project and to obtain the necessary forecasted values of insurance costs to calculate the profitability of the project. Calculations based on scenario modeling based on a real energy saving project made it possible to obtain insurance costs from 2.2% to 4.5% for 5 years of project implementation. Consequently, the active use of insurance in energy service company projects is advisable, since by increasing project costs by less than 5%, the company can protect itself from a wide range of critical risks for the entire duration of the project.

In general, the use of insurance as a risk management method in energy saving projects is possible only if risk managers' approaches to the formation of insurance cover for project risks are changed.

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