Development of the mechanisms for improving the efficiency and quality of services in the energy sector

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Abstract. This article is devoted to the problems of improving the efficiency of the energy sector enterprises. The article is devoted to the examples of implementation of the policy of efficiency in the enterprise, as well as the legislative support of these activities. In addition, the article discusses an effective tool for managing the reduction of energy costs – energy service contract. Its main advantages and disadvantages in the framework of the implementation of such contracts for the energy industry are described.

1 Introduction

An important task facing the enterprises of the energy sector today is the task of improving the efficiency and quality of services. The solution of this problem may require large-scale investments in the modernization of the industry. Very often it is directly connected with the need to increase tariffs for services for consumers. But a mere increase in rates without an increase in efficiency, unfortunately, does not lead to solving the problem. This way will lead to an increase in the cost of services of such enterprises. The growth of tariffs leads to the fact that the level of their availability to consumers is reduced. Solving the problem of quality modernization of the industry requires a set of organizational and technical measures to improve the efficiency of the energy industry, energy and resource saving, competent cost management. The impact of such activities, in turn, can be a source of additional investment.

For most enterprises to grow, the reduction of energy costs can be achieved due to two main factors:

1. Reduction of services provided to consumers,
2. Reduction of specific energy consumption for the production of services.

One of the largest enterprises in the energy sector (supply of water supply and sanitation) is a water utility. In his example, consider the reduction and optimization of costs in order to improve the efficiency and quality of services provided by the energy

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sector. The volume of services provided to consumers has been declining since 1991. The reduction in the volume of services in this case is understood as a reduction in the supply of drinking water to consumers. This decrease in the results of the analysis is the result of the following factors:

1) Reduction of specific water consumption of the population and enterprises in St. Petersburg (the trend is typical for the industry as a whole).

2) Optimization of unaccounted water consumption and losses.

Despite the fact that the reduction of water consumption, because it leads to a reduction in revenue, in General, this kind of trend has a positive impact on the activities of the enterprise [1]. Rationalization of water consumption by the population and industrial consumers makes it possible to abandon the construction of new facilities for the treatment of drinking water and wastewater, reducing the amount of funding for these purposes and allocate additional funds for the implementation of large investment projects to improve technological processes aimed at improving the quality, efficiency and reliability of services. The main direction of optimization of unaccounted water consumption and losses was the widespread introduction of instrument accounting, which began in St. Petersburg more than 15 years ago. This made it possible to obtain an accurate assessment of the extent of water losses and to identify ways to solve the problem.

In addition, the reduction of unaccounted water consumption and losses during transportation was made possible, including as a consequence of the activities carried out among the population and enterprises, sue "Vodokanal of St. Petersburg" educational activities aimed at the formation of a culture of water use.

According to the conducted research, he has been working with consumers for more than 20 years and has provided full instrumentation of his services. On the basis of the data of the instrument account it is established that for the period from 1991 to 2010 the average water consumption per 1 person in St. Petersburg decreased from 305 to 188 liters per day, and in some areas of the city, and to 150.

In General, the city's unaccounted water consumption and losses during transportation decreased from 24% in 1997 to 12% in 2010, with an average of 18.8%.

The second direction of cost reduction is to reduce the specific energy consumption for the production of services.

Reduction of energy costs at the enterprises can be represented schematically in two main directions:

- * Reducing the cost of electricity
- * Reduction of electricity consumption

If we consider this reduction on the example of the water Utility, within the framework of this enterprise, the main reduction occurred as a consequence of a number of energy-saving measures, which include the following events:

1. Creation of the system of complex control of water supply and Sewerage,
2. Construction of sludge incineration plants,
3. The introduction of new reagents and processes.

The creation of a control system for the water supply and Sewerage complex in St. Petersburg allowed to significantly reduce energy costs due to the implementation of the following measures:

* Implementation of a system for monitoring the hydraulic mode of water supply in the water supply zone and a set of tools to protect networks and stations from hydraulic shock

- * Automated water balance
- * Highly efficient energy-saving pumping equipment
- * Optimal control system of water supply mode

In General, it can be noted that measures for the introduction of energy-saving technologies are currently being actively implemented by all enterprises, while the cost of

electricity is steadily increasing [2]. The main areas that can significantly reduce the energy load are activities aimed at:

- * modernization of equipment of production facilities,
- * introduction of new energy-saving technologies.

Within the framework of the water Utility, such activities were: a Pilot project in the K-17 zone, Modernization of the southern water supply zone.

Fig. 1. Energy costs reduction.

The first Pilot project was implemented in the K-17 zone. At the moment, a water supply management system is being created in the southern water supply zone of St. Petersburg, covering about 40% of the city. In the future this system will be developed in the Northern and Central zones of water, but also in the basins of the Sewerage facilities. Thus, the whole territory of St. Petersburg will be covered by the unified management system of water supply and Sewerage complexes.

The following new design and technical solutions were implemented as part of the project to create a "water supply complex management System in the K-17 zone:

1. Modernization of pumping stations using energy-efficient pumping equipment;
2. Installation of network equipment to improve the hydraulic operation of the water supply network;
3. A unified system of collection, transmission and processing of information on the amount of water supplied, sold, as well as pressures at the control points of the distribution network is organized:

The implementation of the pilot project on creation of system of complex control of water supply in the area-17 has achieved the following results:

- * 39% reduction in energy consumption%;
- * reduction of accidents on networks by 32%;
- * reduction of unaccounted water consumption and losses by 32%.

Reconstruction of water supply facilities in the southern zone is carried out on the basis of the approved by the government Of St. Petersburg on August 10, 2010 N 1057 long-term target program of St. Petersburg "on energy saving and energy efficiency of water supply systems of the southern zone of St. Petersburg for the period up to 2012".

Within the framework of this program in the southern zone of St. Petersburg the equipment of 5 nominal and 29 numbered pumping stations has been modernized. In

addition, data transmission equipment with pulse output is installed for all groups of subscribers and other energy-saving equipment.

As a result of the reconstruction of pumping stations in the southern water supply zone of St. Petersburg, it is planned to reduce electricity consumption in the southern zone by 30.7 million kW.h. per year (by 41.7%), and water losses on networks by 11.2 million cubic meters per year (by 36.4%).

By implementing a city-wide water supply management system, we plan to achieve the following results:

1. Reduction of electricity consumption by 35%,
2. Reduction of unaccounted expenses and water losses during transportation by 34%
3. The reduction of accidents on the networks of the water supply system 30%
4. Reduction of operating costs for maintenance and repair of equipment.

It should be noted that the introduction of alternative/renewable energy sources is of great importance for the urban energy-efficient environment. Under such projects can be understood as the construction of a sludge incineration plant.

For example, the construction of three wastewater sludge incineration plants in St. Petersburg allowed the water Utility not only to solve one of the most difficult environmental problems-the complete utilization of sewage sludge, but also to use its combustion energy as a source for generating electricity and heat, reducing energy consumption from external sources by up to 10 million kW.h per year.

A large number of Russian public sector enterprises need to implement such measures. Thus, the use of energy service measures is also relevant for public sector enterprises [3, 4].

2 Methodological approaches and analysis

The article analyzes the legal foundations and trends in the development of this form of interaction. Modern methods for energy saving and increasing energy efficiency in Russia are regulated on the basis of the Federal law No. 261 "on energy saving and energy efficiency".

When concluding energy service contracts, it is necessary to conduct an energy service survey [5, 6].

The concept of energy survey is introduced by the Federal law № 261 "on energy saving and energy efficiency". According to the Law (№ 261-FZ) energy survey [7] can be carried out in respect of products, including buildings, structures, technological processes, as well as legal entities or individual entrepreneurs. In accordance with the law, the main objectives of the survey are to obtain data on the volume of energy resources used, to determine energy efficiency indicators, energy saving potential and energy efficiency improvement, as well as to develop energy saving measures and estimate their cost.

The law also establishes a list of persons for whom an energy survey is mandatory. These include, in particular, organizations engaged in the production and (or) transportation of water, natural gas, thermal energy, electric energy, production of natural gas, oil, coal, production of petroleum products, processing of natural gas, oil, transportation of oil and petroleum products.

Activities for the energy survey [8] may be carried out only by persons who are members of self-regulatory organizations. The law establishes the requirements to be met by self-regulatory organizations in the field of energy survey [9].

The energy survey is conducted on a voluntary basis. However, the law establishes a list of persons for whom an energy survey is mandatory. These include, but are not limited to:

- the organizations performing production and (or) transportation of water, natural gas, thermal energy, electric energy, production of natural gas, oil, coal, production of oil products, processing of natural gas, oil, transportation of oil, oil products

- the organizations which total expenses on consumption of natural gas, diesel and other fuel, fuel oil, thermal energy, coal, electric energy exceed 10 million rubles for calendar year

- organizations engaged in regulated activities, etc.

Persons for whom an energy survey is mandatory are required to organize and conduct the first survey before December 31, 2012, and subsequent energy surveys should be carried out at least once every 5 years.

The results of such energy audit are the basis for the procedure of preparation and conclusion of energy service contracts [10, 11].

The concept of "Energy service contract" was introduced in article 19, Chapter 5 of the Federal law № 261-FZ "on energy saving and energy efficiency and on amendments to certain legislative acts of the Russian Federation."

The law describes energy service contracts or contracts that allow individuals and legal entities to achieve energy savings without investing their own funds at the expense of the energy service company. Payment under the energy service contract is formed on the basis of the cost of energy resources saved. In some cases, it is possible to use energy service contracts (contracts), combined with contracts for the supply of energy resources. This situation is possible in the case of contracts with non-state customers, with state and municipal customers such contracts are not allowed by law.

The main purpose of the energy service agreement or contract is a comprehensive implementation of measures to improve the energy efficiency of the facility or enterprise.

It should be noted that the energy service contract is compensatory, since the contractor (energy service company) for the actions aimed at energy saving and increasing the energy efficiency of energy resources consumption, should receive a reward from the customer.

Customers in this contract can be any enterprise, including state, management company, HOA and even a private homeowner [12].

The amount of such remuneration shall be determined by agreement of the parties. At the same time, the law provides for an attractive way for the customer to determine it: the amount of remuneration of the contractor is equal to the amount of funds saved as a result of energy-saving measures. Therefore, payment under the energy service contract should be made only after the introduction of energy saving measures. For example, if as a result of installation of new equipment, modernization of systems, etc. there is no planned reduction in the volume of energy consumption under the contract, the contractor is not entitled to claim compensation.

Fig. 2. Payment scheme at the conclusion of the energy service contract.

Federal law No. 261 "on energy saving and energy efficiency" introduces obligations for resource supplying organizations, as well as for management organizations to offer measures for energy saving and energy efficiency to the population, including through the implementation of energy service contracts.

The law imposes certain requirements on the content of such contract, which include the following items:

1. The required amount of energy saving provided by the contractor within the framework of the concluded agreement,
2. The term of the contract, which must be at least the period required to achieve savings.
3. Description of responsibilities of the contractor (organization) to ensure agreed by the parties modes of use of energy resources.
4. Description of the contractor's obligation to install and put into operation metering devices used energy resources.
5. Agreed during the negotiations, the price of the contractor's services, which is formed on the basis of the achieved energy savings.

The subject of the energy service agreement is the implementation by the contractor (energy service company) of actions aimed at energy saving and improving the efficiency of energy resources use by the customer [10].

The energy service agreement is bilateral, since each of the parties to this agreement (the customer and the contractor) has obligations in favor of the other party and is considered to be the debtor of the other party (obliged to do something in its favor) and at the same time its creditor (has the right to demand something). In addition, the terms of the energy service contract may be included, in particular, in the contracts of sale, supply, transfer of energy resources (except for natural gas).

Thus, the provisions of the law on energy saving apply to contractual relations in the markets (wholesale and retail) of both electricity and heat. Now subjects of the markets of electric and thermal energy have the right to include in the contracts mediating the relations on production and transfer of energy, conditions of the energy service contract.

As part of the established practice, the execution of the energy service contract involves several stages:

1. Installation of metering devices of all used resources. To solve this problem, previously installed metering devices for cold and hot water, heat and electricity are installed or brought into compliance with applicable requirements. After installation or modernization of units or metering systems, they must be put into commercial operation by resource supply organizations. By metering devices recorded the results of the energy service contract.
2. Installation of an automated system for collecting data on the consumption of used resources. This system is necessary for operational data collection, which is especially important if there are many metering units and they are geographically separated and automated reporting for resource supply organizations, as well as operational monitoring of the performance of metering devices.
3. Maintenance of constant working capacity of metering devices. It is achieved through service, which includes monitoring the serviceability of devices, operational repairs in case of failure, the implementation of routine maintenance (cleaning, metrological verification, etc.).
4. Energy inspection (energy audit) of the facility. Energy audit determines the parameters of resource supply of the object, reserves of saving resources, measures to save them, cost and payback period.
5. Implementation of resource-saving measures. At this stage, the required parameters of saving the consumed resources under the contract are achieved. Activities can be divided

into organizational and technical, as well as small, medium and large-cost. In particular, one of the measures may be the installation of automatic control systems of heat supply, ensuring accurate maintenance of the heat supply parameters of objects, depending on the outdoor temperature and other factors.

When concluding an energy service contract, it is also necessary to pay attention to the necessary requirements for its executor. Thus, the contractor must have permits for the following types of work:

- design;
- installation and adjustment of accounting systems and automated data collection systems;
- maintenance and repair of measuring instruments;
- energy inspection of objects.

After fulfillment of the contract by the contractor, the customer within the framework of the energy service contract must start to make a profit at the expense of the saved resources within the period established by the contract.

In addition, the customer has the right to opt for the best option of energy-saving measures in accordance with your capabilities. Also in the framework of such a contract possible implementation of trial measures for the evaluation of the obtained results before proceeding to large-scale action for the reorganization of the existing objects.

You can start small, in areas where savings will be most noticeable. For example, by replacing the lighting system with a more efficient one (LEDs or by installing optical-acoustic switches) or by increasing the thermal protection of enclosing structures, doors and Windows. A more detailed list of energy service contract activities can be found on our website in the section of energy service programs.

Fig. 3. Payments under the energy service contract.

The practice of concluding such contracts is presented in various sources [13-15].

3 Results

If we consider the possibility of implementing energy service contracts on the example of the St. Petersburg water utility, we can draw attention to the fact that a number of activities proposed in the framework of energy saving work has already been carried out within the framework of other orders of the enterprise [16].

An example of the work is the program on energy saving and energy efficiency of St. Petersburg' enterprises developed at the enterprise, which included the following activities (Table 1).

Table 1. Some activities within the program on energy saving and energy efficiency of St. Petersburg' enterprises.

Type of event	Implemented technological projects
Introduction modern models of equipment energy audit.	Conducting an energy survey. Development of energy saving program.
High technical characteristics.	Replacement of oil high-voltage switches with vacuum ones. Reduce operating costs.
The Reduction of accidents on the networks.	Implementation of the emergency switches
Increasing the service life of pumping units.	Introduction of frequency converters and soft starters. Significant reduction in energy consumption.
Reduction of the share of purchased electricity.	Use of secondary energy resources.
Reduction of energy consumption by 3-4 times paza.	Modernization of lighting systems using LEDs.

In addition, the company implemented a number of other activities, including:

1. The creation of a hydraulic model that allows you to optimize the operation of the water network in order to eliminate excess pressure and improve speed.

The hydraulic model allows determining the strategy of optimization of the water supply network (elimination of excess pressure, improvement of speed, construction of a modern control system of hydraulic modes)

2. Modernization of twelve pumping stations with replacement of pumping equipment, which allowed to reduce energy costs by selecting pumping units for hydraulic characteristics of the network and higher efficiency.

Modernization of pumping stations can reduce energy costs by increasing efficiency and the introduction of automated control of the pressure on the dictating points on the networks

3. The introduction of automatic control system of work of pump station, to eliminate excessive pressure on the basis of the analysis of pressures from consumers, which provides additional reduction of energy consumption/

Installation of modern fittings allows increasing the reliability and ensuring the smooth operation of the network, eliminating hydraulic shocks, eliminating air plugs

4. At the pumping stations to install devices that prevent water hammer and installed on the network with 49 nodes remove air accumulations, allowing optimizing the network

5. The introduction of a pilot system for remote retrieval of readings of water consumption of the subscribers, providing the construction of water balance, water distribution monitoring in the network and the possibility of identifying water losses due to leaks [17, 18, 19].

Installation of metering devices with pulse output and data transmission equipment allows for the construction of water balance, water consumption monitoring and leakage control

6. Implementation of water quality monitoring system in water supply networks.

Installation of pumps put in homes to reduce pressure in the network and to reduce the accident rate without mass replacement of tubes and at the same time to provide a comfortable water use in conditions of increase of requirements of consumers to the water heads [20, 21]. All these measures generally influenced the results of energy efficiency of

the enterprise and led to a significant reduction in energy costs in the production and provision of services [22, 23].

4 Conclusion

To optimize resource saving, before making a decision on financing capital investments and other operating costs, it is necessary to carry out a lot of work, which should ensure the efficiency of both operational and investment costs while maintaining tariffs at a level accessible to consumers.

This work should be carried out in close cooperation between the WCC organizations and public authorities in order to make this process as objective as possible, transparent and accessible to society. First of all, it is necessary to inventory and technical expertise of water supply and sanitation systems for their compliance with modern requirements for quantitative and qualitative parameters of services.

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