Modern Trends of Development of Energy Saving Management in Organization

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Abstract. The modern agenda of energy saving management in the management of organizations dictates the need to involve automated systems for utility monitoring and metering. As the information sources, the data on the use of closed methods for assessing the effectiveness of a transition between price categories in the implementation of complex solutions in connection with the creation of automated information and measurement systems for utility monitoring and metering at industrial enterprises have been analyzed. Within the framework of this paper, the main opportunities of introducing automated information and measuring measurement systems for utility monitoring and metering have been presented, as well as their key advantages over traditional metering devices. This study explores the technology of smart metering and real-world measurements derived from the activities of a commercial company. And the article also presents the application of the proposed methodology to determine the basic results related to energy saving and improving the economic efficiency of the company.

Keywords: Energy saving · Energy efficiency · Organization management · Electricity metering

1 Introduction

Domestic and foreign literature pays significant attention to the issues of organizing the management of energy saving and increasing energy efficiency.

This paper is related to the study of local problems of energy management in connection with the fact that the study of energy conservation management issues is associated for the most part with the description of technological capabilities, their impact on potential cost-effectiveness.

The result of the issue under consideration is the reflection of the economic effect from the introduction of local energy saving mechanisms – the installation of automated systems for utility monitoring and metering without developing an expensive energy saving system and assessment of the current energy balance of the enterprise.

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As noted in industry research papers [1], accurate and cost-effective large-scale energy forecasting is a vital step towards next-generation energy efficiency initiatives.

2 Methods

Smart metering is a critical method for organizing more accurate asset management and for developing a new awareness of energy use. The smart meter is solely designed to check the energy consumption and control each electronic equipment [2].

Zykov [3] puts a need to create effective energy metering systems both for utilities and for industrial enterprises. An attempt to find a comprehensive solution to the problem of energy metering implies an increase in the metering efficiency using automation methods, modernization and implementation of up-to-date engineering equipment and energy metering systems.

Innovations in the energy sector lead to an increase in the efficiency and quality of generation, conversion, transport, storage and distribution of electric and thermal energy, to a decrease in the negative environmental impact and, in general, provide opportunities for economic growth [4].

The first step in reducing energy costs is to recognize the importance of energy as a costly resource rather than as an overhead for an enterprise. It is necessary to exclude from practice the attitude to energy saving as to a specialized engineering activity, since energy is an object of production management, not just a technical element [5].

Improving energy efficiency is an indispensable condition for ensuring competitiveness and the main motivation for achieving energy efficiency indicators through the modernization of equipment, the use of new technological solutions, as well as the introduction of organizational measures [6].

Having analyzed the profile studies [7–10] it is proposed to identify the following some economic barriers to the implementation of energy-saving technologies:

- non-market barriers (heterogeneity of economic agents, economic market failures);
- technological market failures;
- asymmetry of information;
- floating technology costs;
- inconsistency of motives and conditions for the introduction of energy-saving technologies;
- hard access to credit capital;
- high level of investment risks.

Utility monitoring and metering, in turn, can help to manage an enterprise more efficiently, in a timely manner and provide full accountability for activities financed from borrowed capital.

Energy consumption can be monitored and analyzed for various reasons. The root cause may be related to operating costs, building's performance, customer expectations, rental commitments, production efficiency, continuity of service, sustainability goals, or management reporting.

Energy metering software provides analysis of energy use and distribution of costs for individual generating units, areas and the entire system.

Reports are segmented by energy cost analysis, profit making, production billing, energy consumption and can be made out for generators and intersystem exchanges.

To identify the general need for metering devices, their types and areas with the highest energy consumption, it is necessary to conduct a complete inventory of the capacities and equipment involved in manufacturing.

After the formulation of motives and a preliminary assessment of the goals of introducing electricity metering and monitoring, the next step is to consider possible costs and draw a preliminary budget.

Actual capital costs and subscription fees for the electricity metering and monitoring system varies depending on the nature of the facility, the needs of the facility and the selected equipment supplier.

An overview of energy management and monitoring platforms ranges from the simplest to the most complex.

Specialized energy survey and analysis service providers offer platforms that collect data from multiple sources including gauges, temperature sources, other sensors and billing data, provide real-time monitoring, visualization and reporting data, interpret data in analytical systems and provide active monitoring and optimization of the system.

Modern realities of the regulatory framework in terms of the implementation of intelligent energy metering systems affect to a greater extent three main market players:

- guaranteeing suppliers of electrical energy;
- power grid companies;
- developers.

The need to install metering devices for guaranteeing suppliers and grids occurs under one of the following conditions:

- a device is out of order;
- a device was absent;
- within a technological connection.

Metering devices must comply with the rules for providing access to a minimum set of functions:

- transmission of meter readings;
- providing information on the parameters of energy efficiency;
- limitation/resumption of the consumption mode;
- setting/changing zones of the day for summing up the volumes of energy efficiency;
- display (transfer) of settings;
- transfer of reference information;

- transfer of data archives;
- notification of emergency situations.

Implementation of measures to control energy saving can be aimed at:

1. Improving energy management practices, including:
- setting and achieving energy efficiency targets – compared with other facilities;
- establishing an energy background and using it to measure savings from energy conservation measures;
- detecting unexpected increases in energy consumption;
- knowledge of the impact of each piece of equipment or area;
- monitoring the impact of efficiency measures.
2. Cost management, including:
- control of electricity costs;
- charging tenants for the use of electricity;
- control of energy consumption by individual units;
- energy consumption forecast for various operating conditions;
- reduced demand (for example, by managing peak loads and saving costs for paying for network power;
- increasing the efficiency of implementing business cases for the projects seeking to improve efficiency.
3. Quality of corporate reporting in the field of sustainable development, in particular through participation in carbon reduction programs and voluntary sustainability reporting schemes to comply with corporate social responsibility.
4. Supporting funded solutions and grants that assess and verify guaranteed savings under contracts for energy efficiency, including as part of the reconstruction of buildings, etc.
5. Measurement and validation using an internationally recognized method (e.g., The International Performance Measurement and Verification Protocol to check organization's performance by performance ratings) to quantify energy efficiency cost savings.
6. Maintaining compliance with the rules for charging tenants or subleasers for electricity or the use of metering devices for other operations.
7. Troubleshooting and diagnostics, including identification of equipment misalignment and component failure to optimize maintenance and replacement times.
8. Ensuring interaction with any existing control and management systems, for example, BMS, PLC, SCADA – identifying inefficiencies in the control settings and equipment operation and extending its life.

3 Results

Well-designed energy saving programs provide customers of all types with the opportunity to take energy saving measures and cut electricity bills.

To reflect the local effect of smart metering devices without developing an expensive energy saving system and assessing the current energy balance of the enterprise, the experience of their implementation was analyzed at an industrial enterprise in Goryachy Klyuch city.

As part of an analysis of the effectiveness of the implementation of automated information and measuring systems for monitoring and accounting of energy resources, 8 objects were analyzed (Table 1).

Table 1. Distribution of objects by price category.

Object	Voltage level	MMEU group	Optimal price category (Pc)
Water intake 1–2	CH-2	Less than 670 kW	4/6
			4/6
Water intake 1–2	CH-2	Less than 670 kW	4/6
			4/6
Water intake 2	CH-2	Less than 670 kW	3/5
			4/6
Gas pumping station	CH-2	Less than 670 kW	4/6
			4/6
Pump room 3	HH	Less than 670 kW	3/5
			3/5
Pump room 4	CH-2	Less than 670 kW	4/6
			4/6
Sewage treatment	CH-2	Less than 670 kW	4/6
			4/6
Local pumping station Lead-in-1	CH-2	Less than 670 kW	4/6
			4/6
Local pumping station pump room-Dubzavod	CH-2	Less than 670 kW	4/6
			4/6

The costs of installing information and measuring systems for utility monitoring and metering at 8 facilities were distributed by 6 different price categories (Table 2).

Table 2. Distribution of costs by price category.

Object	PC1 Costs, Rub ths	PC2 Costs (3 Day Zones), Rub ths	PC2 Costs (2 Day Zones), Rub ths	PC3 Costs, Rub ths	PC4 Costs, Rub ths	PC5 Costs, Rub ths	PC6 Costs, Rub ths
Water intake 1–2	380.0	408.1	397.6	341.1	260.0	340.2	259.1
Water intake 1–3	366.1	393.2	383.1	328.7	250.5	327.8	249.7
Water intake 2	393.4	426.1	428.6	344.8	346.7	344.0	345.8
Gas pumping station	173.6	186.5	181.7	154.6	116.2	154.2	115.8
Pump room 3	44.4	42.9	44.0	39.8	60.1	39.7	60.0
Pump room 4	101.4	115.9	112.7	95.0	77.1	94.8	76.9
Sewage treatment	418.7	449.7	438.2	375.9	286.5	374.9	285.6
Local pumping station Lead-in-1	133.4	143.3	139.6	119.8	91.3	119.5	91.0
Local pumping station pump room-Dubzavod	48.3	52.5	51.7	43.6	35.9	43.5	35.8

The cost for price category 1 amounted to 277,463.68 rubles excluding VAT. The cost for price category 3 amounted to 275,395.22 rubles excluding VAT, including savings for the reporting period in the amount of 2,068.46 rubles excluding VAT, which is 0.75% (Table 3).

Table 3. Distribution of savings by price category.

Object	Saving (PC2 to PC1), Rub ths	%	Saving (PC2 to PC1), Rub ths	%	Saving (PC3 to PC1), Rub ths	%	Saving (PC4 to PC1), Rub ths	%	Saving (PC5 to PC1), Rub ths	%	Saving (PC6 to PC1), Rub ths	%
Water intake 1–2	−28.1	−7.4	−17.6	−4.6	38.9	10.2	120.0	31.6	39.8	10.5	120.9	31.8
Water intake 1–3	−27.1	−7.4	−17.0	−4.6	37.5	10.2	115.6	31.6	38.3	10.5	116.4	31.8
Water intake 2	−32.6	−8.3	−35.1	−8.9	48.6	12.4	46.8	11.9	49.5	12.6	47.7	12.1
Gas pumping station	−12.8	−7.4	−8.0	−4.6	19.0	11.0	57.4	33.1	19.4	11.2	57.8	33.3
Pump room 3	1.5	3.3	393.8	0.9	4.6	10.4	−15.7	−35.3	4.7	10.6	−15.6	−35.1
Pump room 4	−14.5	−14.3	−11.3	−11.1	6.4	6.3	24.3	23.9	6.6	6.5	24.5	24.2

(*continued*)

Table 3. (*continued*)

Object	Saving (PC2 to PC1), Rub ths	%	Saving (PC2 to PC1), Rub ths	%	Saving (PC3 to PC1), Rub ths	%	Saving (PC4 to PC1), Rub ths	%	Saving (PC5 to PC1), Rub ths	%	Saving (PC6 to PC1), Rub ths	%
Sewage treatment	−31.0	−7.4	−19.4	−4.6	42.9	10.2	132.2	31.6	43.8	10.5	133.2	31.8
Local pumping station-Lead-in-1	−9.9	−7.4	−6.2	−4.6	13.7	10.2	42.1	31.6	14.0	10.5	42.4	31.8
Local pumping station Pump room-Dubzavod	−4.2	−8.8	−3.4	−7.0	4.7	9.7	12.3	25.5	4.8	10.0	12.4	25.8

The payment to the energy utility amounted to 55% of the resulting savings: 1,137.65 rubles excluding VAT.

4 Conclusion

Automated systems for commercial metering of electricity are designed to automate utility metering and ensure control of metering indicators in accordance with the established requirements, as well as for automated data transmission to the information collection centers of the energy supplier.

Such systems perform the following functions:

- automated commercial and engineering (controlling, technological) metering of the amount of electrical energy, thermal energy (heat carrier), cold and hot water;
- automation of the process of commercial and engineering utility metering;
- increasing the reliability, efficiency and accuracy of metering due to up-to-date metering devices and increasing the degree of protection of equipment and commercial information from unauthorized interference.

References

1. Jain, R.K., Smith, K.M., Culligan, P.J., Taylor, J.E.: Appl. Energy **123**, 168–178 (2016). https://doi.org/10.1016/j.apenergy.2014.02.057
2. Kurde, A., Kulkarni, V.S.: Int. J. Sci. Res. Publ. **6**(9), 411–415 (2016)
3. Zykov, D.D., Urazaev, D.R., Khabibulina, N.Yu.: Rep. TUSUR **20**(4), 131–134 (2017). https://doi.org/10.21293/1818-0442-2017-20-4-131-133
4. Mikheev, A.V.: Inf. Math. Tech. Sci. Manag. **4**(20), 158–167 (2020). https://doi.org/10.38028/ESI.2020.20.4.014
5. Kharchenko, V.V., Panchenko, V.A.: E-Scio **5**(44) (2020)
6. Ilyina, M.N., Ilyina, G.F.: TPU Bull. 91–98 (2018)

7. Agybayev, M.Sh., Rakhimbekova, Zh.S.: Eur. J. Econ. Manag. Sci. **2**, 96–100 (2020). https://doi.org/10.29013/EJEMS-20-2-96-100
8. Choi, K.S., Hong, S.: New design approaches and implementation of smart metering system. In: The 18th IEEE International Symposium on Consumer Electronics, 2014, pp. 1–2 (2014). https://doi.org/10.1109/ISCE.2014.6884309
9. Živic, N.S., Ur-Rehman, O., Ruland, C.: Evolution of smart metering systems. In: 2015 23rd Telecommunications Forum Telfor (TELFOR) 2015, pp. 635–638 (2015). https://doi.org/10.1109/TELFOR.2015.7377547
10. Liu, X., et al.: J. Clean. Prod. **251**, 119693 (2020). https://doi.org/10.1016/j.jclepro.2019.119693