

Economic features of services and energy cost for engineering systems

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Abstract. There are the results of some municipal services actual specific cost for residential apartment building. These services consist of cold water supply system; drainage and sewage systems; electricity; collection and disposal of municipal solid waste system. Authors did not indicate the specific operating cost for hot water supply and heating systems because their cost was constant. Research period: from 1st quarter of 2018 year to the 2nd quarter of 2022 year. This period was acute phase of Covid-19 pandemic period. Authors have written the dynamics changes in the cost of considered services. Researchers have presented additional factors which affect to the unit cost of municipal services in this paper. There is a brief overview of management companies types which could be in municipal service system. Also it has been considered their capabilities and limitations in creating tariffs process. Authors have identified different trends in the engineering service unit cost changing process. This article could be interested for management companies and tariffs planning departments of public municipal service system in different parts of Russian Federation. Results which were presented in this paper could be used in predictive mathematical models of municipal services economical parts in critical as pandemic or other emergency situations.

1 Introduction

The cost of providing the service depends on a large number of factors that must be taken into account from the very beginning of the production of the goods to its delivery to the retail space and direct sale to the buyer. A typical example of the provision of a service is the production of a product that consists of a different number of components. A change in the price of each component lead to a change in the final cost of the product. A good example is goods for machine-building or other enterprises [1-3]. Despite the fact that there are various regulatory organizations, for example, the World Trade Organization (WTO), which, according to the original plan, should always be outside political systems and act on

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the basis of contractual partnerships, currently such organizations, unfortunately, are guided by other views on trade relations.

One of the most labor-intensive services are the services of housing and communal services (HCS) companies. Apart from the complexity in the number and types of services, there are often quality problems with the services provided due to the many factors affecting their final cost. Due to the current political situation in the world and sanitary and epidemiological restrictions, it is necessary to study the unit cost of services provided in the housing and communal services sector for various buildings and structures. Afterwards these data can be used in forecasting and modeling similar problems in the future and assessing their impact on economic parameters [1,4,5].

In foreign countries, research in housing and communal services is aimed at predicting the cost of resources when changing sources of electricity generation (including renewable energy sources) [6-8], decentralizing sources and improving the efficiency of water treatment and sanitation systems [9-11]. For municipal solid waste (MSW), economic comparisons are made in the direction of introducing innovations in the waste processing industry (mainly technologies for the extraction of landfill gas) [12].

2 Materials and methods

In this paper, a study was made of the change in the unit cost of some housing and communal services for water supply, energy supply, collection and disposal of municipal solid waste (MSW) of an apartment building. The building is located in the Pushkinsky District (Ivanteevka) of the Moscow Region, microdistrict «The Dutch Quarter». The analysis used data from open sources, namely from a single payment document (SPD). Tariffication of housing and communal services in the Russian Federation has its own characteristic features due to the difference in the form of ownership of some objects, various types of management companies that, with proper justification, set their own tariffs (for example, of Homeowner Associations "HOA" or Housing Cooperatives "HK") and other factors. State management companies are guided by the Federal Laws (FL), Decrees of the President of the Russian Federation or the Government of the Russian Federation, as well as decrees and other mandatory regulatory documents in the federal regions where the company is located. In Moscow, for example, these are the "Zhilishchnik" of the districts, which were transformed from Building Maintenance Directorates "BMD" [13]. Some of the companies' work results were described in detail in the papers of Goranova O.A., M.D.Zhuravlev and other authors [14, 15].

In the microdistrict under study, the management company is a private organization without state participation, so the tariffs are regulated according to the current prices for the services provided by subcontractor companies. The microdistrict lacks its own sources of electricity generation (no renewable energy sources), which are owned by the management company, so the selling price for electricity is regulated by the electricity supplier. According to the data of the company supplying electric energy and servicing this area, there are 3 types of electric energy consumption: peak, semi-peak and night, and accordingly there are 3 tariffs. But there is only one tariff used for the provision of electrical energy in this residential apartment building due to the lack of funds from the management company to replace the existing electrical energy metering equipment with modern three-tariff analogues. The source of drinking quality water in the microdistrict is the city water supply system, served by the Ivanteevka water canal. The sewerage system is also serviced by this company. Providing thermal energy is carried out by individual gas boilers. Fuel for boiler units is provided by Mosoblgaz. The cost of natural gas is not included in the SPD and is regulated by Mosoblgaz. The collection and disposal of MSW is also carried out by a private company and is regulated according to its tariffs.

3 Results and discussion

Figure 1 shows the change in the cost of 1 kWh of electrical energy for the multi-apartment residential building located in the Moscow region since 2018 till 2022. There are no industrial customers in the building under consideration.

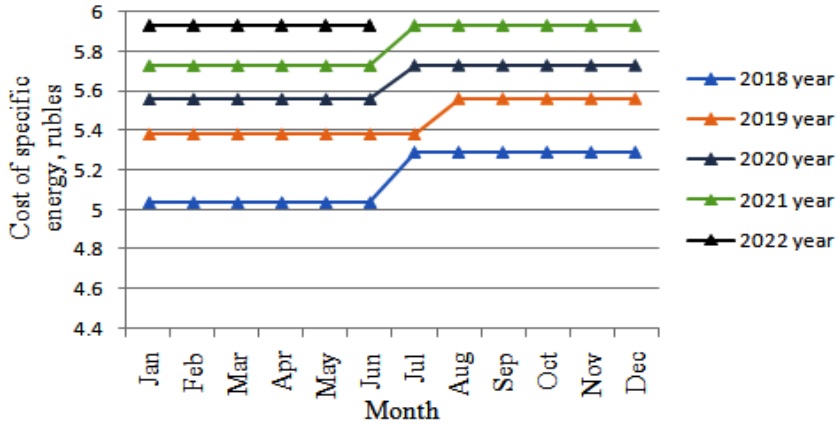


Fig. 1. Change in the unit cost of electrical energy (1 kWh) from 2018 till 2022.

It is worth paying attention to the constant abrupt increase in the price for 1 kWh of electric energy in July of each year. The average growth is 0.15 - 0.20 kopecks. This growth is explained by the indexation of prices for almost all types of housing and communal services due to annual inflation.

Figures 2 and 3 show experimental data on changes in the actual cost of providing the population of the building with cold water supply and sanitation.

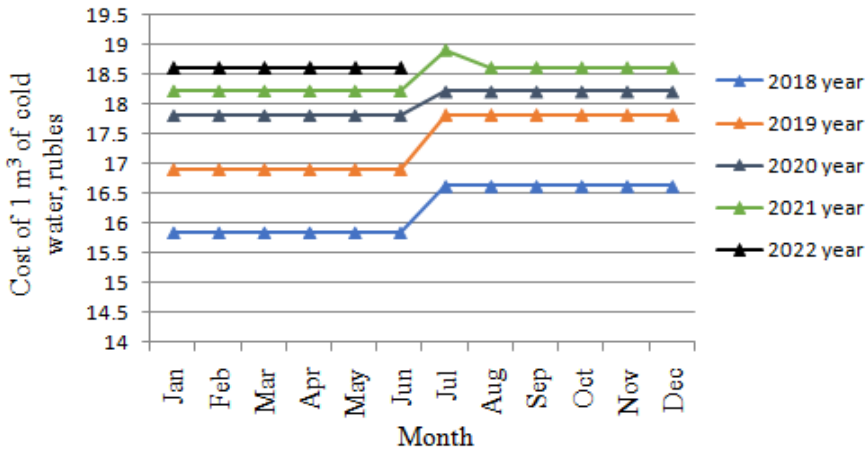


Fig. 2. Change in the unit cost of cold water (1 m³) from 2018 till 2022.

The results obtained you can see in Figures 2 and 3 show that price indexation for these services takes place in July. It should also be noted that the same services can be indexed in January of each year. For the systems under consideration, a price correction in terms of cost reduction is also possible. The average increase in the cost of water supply for customers of the building in July amounted to 0.40 - 0.90 kopecks per 1 m³ of cold water, and in January by an average of 0.28 kopecks.

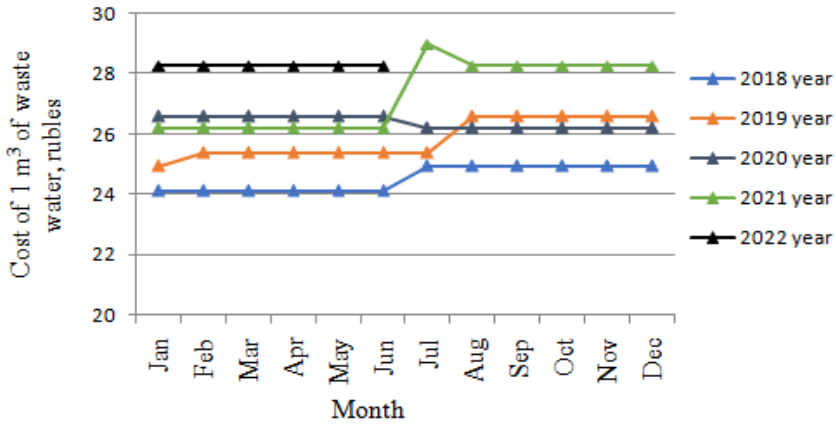


Fig. 3. Change in the cost of sewerage for 1 m³ of wastewater from 2018 till 2022.

For the sewerage system, the increase in the cost of removing 1 m³ of wastewater in July ranged from 0.19 to 0.22 kopecks. The cost reduction for both systems was recorded once in August 2021, and additionally in 2020 the cost reduction took place for the sewerage system. For the sewerage system, it amounted to 0.71 kopecks, and for the cold water supply system to 0.30 kopecks. The correction of the cost is explained by a decrease in the cost of transportation and treatment of water and wastewater by Vodokanal in Ivanteevka due to a temporary decrease in the district’s population.

Figure 4 shows the results of a study of changes in the cost of MSW collection. A feature of the service is that its cost refers to 1 m² of the area of apartments. Also, this indicator can refer to 1 m³ of waste or 1 inhabitant [16-18]. In 2018, the price for waste removal in each month was constant and amounted to 5.2 rubles per 1 m² of the apartment area. In 2019, the cost of the service was 8.23 rubles. Only in July 2020, an increase in the cost was recorded, which amounted to 0.24 kopecks. In 2021 and 2022 (in 2022 until June), the price for the MSW collection was also constant and amounted to 8.47 rubles.

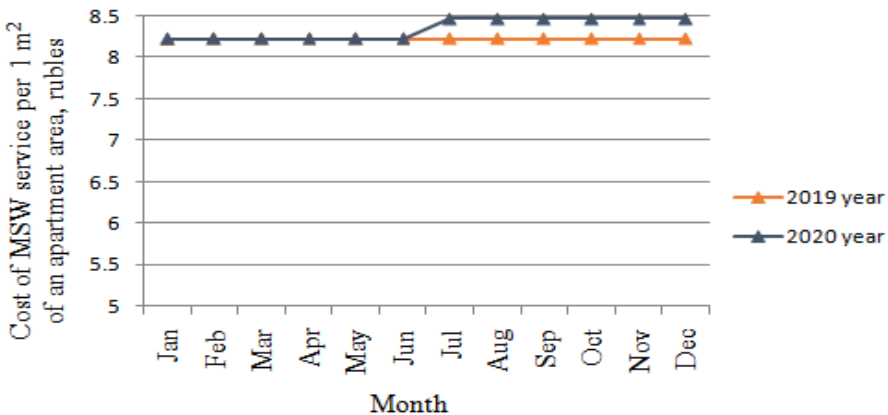


Fig. 4. Change in the cost of using a centralized MSW collection site per 1 m² of an apartment area from 2019 till 2020

4 Conclusion

The study revealed that the average change in the cost of housing and communal services for a residential apartment building ranged from 0.19 to 0.90 kopecks in different periods. Half of the services provided showed an increase in unit cost, and the water supply and sewerage systems showed a slight decrease in 2021. The cost increase is influenced by with inflationary indexation of prices for goods and services in the Russian Federation. For a detailed analysis of changes in the cost of providing housing and communal services for other buildings in this region, it is necessary to study the cost of a similar set of services for buildings and structures for industrial and public purposes.

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